Wildland Fire Origin and Cause Determination FI-210

NFES 002816

Instructor Guide

APRIL 2016

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CERTIFICATION STATEMENT

on behalf of the

NATIONAL WILDFIRE COORDINATING GROUP

The following material attains the instructional design standards prescribed for training products developed and coordinated by the National Wildfire Coordinating Group. The training material is certified for interagency use and is known as:

Wildland Fire Origin and Cause Determination, FI-210

Operations and Training Committee Chair

4/1/16
Date

NWCG OPERATIONS AND TRAINING COMMITTEE
POSITION ON COURSE PRESENTATION AND MATERIALS

The recommended hours listed in the FMCG are developed by Subject Matter Experts based on their estimation of the time required to present all material needed to adequately teach the unit and course objectives. The hours listed may vary slightly due to factors such as number of students, types and complexity of course activities, and the addition of local materials.

NWCG does not approve of course delivery varying greatly from the recommended course hours. Instructors and students are cautioned that in order to be recognized as an NWCG-certified course, certain guidelines must be followed:

- Lead instructors are encouraged to enhance course materials to reflect the conditions, resources, and policies of the local unit and area as long as the objectives of the course and each unit are not compromised.
- Exercises can be modified to reflect local fuel types, resources, and conditions at the location where the student will likely fill incident assignments. The objectives and intent of the exercises must remain intact.
- Test questions may be added that reflect any local information that may have been added to the course. However, to ensure the accurate testing of course and unit objectives, test questions in the certified course materials should not be deleted.
- Test grades, used to determine successful completion of the course, shall be based only on the questions presented in the certified course materials.

If lead instructors feel that any course materials are inaccurate, information should be submitted either by accessing the online feedback form at http://training.nwcg.gov/ (select the "NWCG EVAL" button in the upper right corner) or by sending an email to the NWCG Training Branch at BLM_FA_NWCG_training@blm.gov. Materials submitted will be evaluated and, where and when appropriate, incorporated into the appropriate courses.

COURSE LENGTH FOR NWCG COURSES

Recommended course hours and the "NWCG Position on Course Presentation and Materials" above will be adhered to by the course instructors (see below for exception for criteria-based courses).

- Recommended unit times represent the allotted time to teach the unit and complete the exercises, simulations, and tests.
- Recommended course hours are provided to help the students and the course coordinator plan for travel, room reservations, and facilities usage. The recommended course hours represent the time estimated to present the NWCG-provided materials including time for breaks, lunch periods, to set up for field exercises or simulations, etc.
- Actual times for both the unit(s) and the course may vary based on number of students, types and complexity of course activities, and the addition of local instructional materials.

If the course is criteria based, e.g., L-380, and has been developed using NWCG course criteria, minimum course hour requirements have been established and must be adhered to by the course developer and course instructors.

Course hours for all NWCG courses can be found in the Field Manager's Course Guide at www.nwcg.gov/pms/training/training.htm. If the hours are a minimum versus recommended, they will be stated as such.

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Sponsored for National Wildfire Coordinating Group (NWCG) publication by the NWCG Training Committee. Comments regarding the content of this publication should be directed to the NWCG Training Branch at BLM_FA_NWCG_Training@blm.gov.

For additional copies of this publication, go to Publications at http://www.nwcg.gov.

Previous editions: this product replaces *NFES 2816, Wildland Fire Origin and Cause Determination, September 2005*.

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PREFACE

Wildland Fire Origin and Cause Determination, FI-210, has been developed by an interagency development group with guidance from the National Interagency Fire Center (NIFC), Fire Training under authority of the National Wildfire Coordinating Group (NWCG). The development group consists of the following representatives:

Brenda Rice (Schultz) WFISC Chair 2012- 2014
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Jim Engel WFISC Chair 2015- present
CalFire

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Bureau of Land Management

Jeff Bonebrake WFISC Chair 2009-2010
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United States Forest Service

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NWCG

The NWCG appreciates the efforts of these personnel and all those who have contributed to the development of this training product

CONTENTS

The following appendixes are located on the Course Materials CD:

COURSE INSTRUCTIONS

This section contains instructions and information essential to the course coordinator and instructors in making an effective presentation. Cadre members must read this section and be thoroughly familiar with course procedures and material before presentation.

I. INTRODUCTION

The Wildland Fire Origin and Cause Determination, FI-210 course requires 36 hours for presentation. This course is designed to meet the training needs of a Wildland Fire Investigator on an incident as outlined in the National Incident Management System Wildland Fire Qualification System Guide (PMS 310-1) and the position task book developed for the position.

The National Incident Management System Wildland Fire Qualification System Guide (PMS 310-1), developed under the sponsorship of the National Wildfire Coordinating Group (NWCG), is designed to establish minimum requirements for training, experience, physical fitness level, and currency standards for wildland fire positions, which all participating agencies have agreed to meet for national mobilization.

To ensure that the most up-to-date material is being presented, instructors are encouraged to refer to the NWCG Training and Qualifications website. This website contains current updates for all NWCG courses (go to http://training.nwcg.gov/).

This FI-210 course contains eight classroom lecture/discussion units, three practical exercises, one team practical examination, one individual practical examination, and a final written examination. Students will have the opportunity to practice new skills in the exercise portions of the class.

II. COURSE OBJECTIVES

Course objectives are stated in broad terms that define what students will be able to accomplish after completing the course.

At the successful completion of this course, students will be able to:

- Perform the common roles and responsibilities of a Wildland Fire Investigator (INVF) involved in an initial investigation environment.
- Practice wildland fire investigation methods, evidence collection, and documentation processes in a realistic environment.
- Identify the laws, regulations, and related court procedures associated with administrative, civil, and criminal litigation processes.
- Describe the fundamentals of investigation.
- Know the elements of professional code of ethics.

III. MINIMUM INSTRUCTOR QUALIFICATIONS

Refer to the Field Manager's Course Guide (PMS 901-1) for instructor prerequisites specific to this course (online at http://www.nwcg.gov/publications).

IV. INSTRUCTOR PREPARATION AND COURSE COORDINATION

A. General Information

The Course Coordinator's Guide (PMS 907) contains general information for presentation of NWCG courses. The course coordinator and instructors should be thoroughly familiar with this guide (online at http://www.nwcg.gov/publications).

B. Exercises and Other Pertinent Information

There are complete, detailed instructions for the practical exercises and the practical examinations located in Appendix C. Instructors **must** review the entire contents of the package well in advance of beginning the course.

C. Course Agenda

A sample agenda is in Appendix A. Revise the agenda as appropriate. The agenda can be inserted into the Student Workbook before the beginning of class. Consider removing timeframes from the agenda that is given to students.

V. COURSE MATERIALS

The Course Materials CD contains the Instructor Guide, Student Workbook, and Appendixes in bookmarked files in portable document format (PDF).

A. Instructor Guide

The Instructor Guide is designed as a teaching aid to assist instructors in presenting the course.

Each unit begins with a Unit Overview that outlines the lesson's approximate delivery time, objectives, and required materials (instructional aids).

The Unit Presentation follows the Unit Overview, and contains the lesson plan for each unit, shown in a two-column format:

- The Outline column contains the lesson content that supports the learning objectives. The column also contains notes to the instructor (directions for conducting an exercise, questions to ask students, etc.), which are in boxes**.**

- The Aids & Cues column lists references (slide numbers, handouts, publications, etc.) that remind instructors to display or refer to specific materials.

B. Appendixes

The following appendixes are on the Course Materials CD:

- Appendix A – Course Ordering and Support Information

  This appendix tells you how to order required components of the course and what additional support materials are needed for course presentation.

  Appendix A also contains samples of a course agenda and selection letter. These documents are in Microsoft Word and can be edited.

- Appendix B – PowerPoint Presentations

  Test the equipment before the start of class to ensure compatibility with software.

  Refer to the READ ME file, located on the CD, which provides information on:

  – Minimum System Requirements to Successfully Run Microsoft PowerPoint 2010 Presentations

    - Editing the original PowerPoint 2010 Files

    - Troubleshooting

- Microsoft PowerPoint Viewer 2010

- References on Creating PowerPoint Slides

- Appendix C – Student Assessment and Practical Exercise Package

  This appendix contains the Final Examination and Answer Key. Duplicate enough copies of the final examination for every student to have one copy.

  This appendix also contains complete, detailed instructions and other materials needed for the practical exercises and the group and individual practical examinations.

- Appendix D – Reference Materials

  The reference material included in this appendix is provided by the National Wildfire Coordinating Group (NWCG) Wildland Fire Investigation Subcommittee and may be periodically updated. The reference material is meant to provide wildland fire investigators with additional and on-going reading and education pertaining to the subject matter contained within the NWCG publication "Guide to Wildland Fire Origin and Cause Determination" 2016 Edition, and the NWCG FI-210 "Wildland Fire Origin and Cause Determination" training course.

  NWCG and the Wildland Fire Investigation Subcommittee does not make any guaranty or warranty as to the accuracy or completeness of any information included as part of the reference material.

- Appendix E – Course Evaluation Forms

  The Student Training Course Evaluation Form allows the students an opportunity to comment on the course and the instructors for the purpose of improving future training sessions. Distribute the form at the beginning or end of the course.

  The Training Course Evaluation Form is an opportunity for the course coordinator and instructors to comment on course design. These comments are used by NWCG Training to identify potential problems with courses and as a resource during the course revision process.

  The Online Course Evaluation Form also allows for feedback. Comments/feedback can also be submitted online at http://training.nwcg.gov under Training and Qualifications.

C. Student Workbook

The Student Workbook contains the same course information as the PowerPoint presentations. Student Workbooks should be ordered before the beginning of the course, one for each student.

VI. STUDENT TARGET GROUP

The target group should consist of individuals with at least one year of experience as a firefighter or law enforcement officer desiring to become qualified Wildland Fire Investigators (INVF).

VII. COURSE PREREQUISITES

Refer to the Field Manager's Course Guide (PMS 901-1) for current course prerequisites.

VIII. PRE-COURSE WORK AND PRE-SELECTION ASSESSMENT

Students are to complete an interactive assignment (self-paced) pre-course work. This will familiarize students with the background information necessary to successfully complete the course.

A score of 70% or higher is required on the assessment prior to attending the classroom portion of the course.

The materials are located online at http://training.nwcg.gov.

The course coordinator should provide the link to the students and list the website in the selection letter (http://training.nwcg.gov). A sample selection letter is located in Appendix A.

Refer to the FMCG for number of hours required to complete the pre-course work and pre-selection assessment.

IX. CADRE MEETINGS

Cadre meetings are an opportunity for instructors to meet, review the material, and discuss concerns with the course coordinator or lead instructor. The meetings are critical for instructors who do not have previous experience with the course. A cadre meeting checklist is located in the Course Coordinator's Guide (PMS 907).

A cadre meeting before each day's course presentation is recommended because of the interrelationship of the unit material (changing instructional materials in one unit may impact a later unit).

After each day's presentation, hold a cadre meeting to discuss concerns and progress. At the end of the course, conduct a final cadre meeting to evaluate instructor performance and suggest modifications for future courses.

X. RECOMMENDED CLASS SIZE

The recommended class size is 30 students. The recommended student-to-instructor ratio is 5:1. Cadre members should be present for all instructional sessions. A minimum of three instructors should present this course. This is to enable strong mentorship by the cadre to the students.

XI. SPACE AND CLASSROOM REQUIREMENTS

The characteristics of the classroom and supportive facilities have a significant impact on the learning environment. The classroom should be chosen and viewed well in advance of the presentation.

The following characteristics should be considered when choosing a location and classroom:

- A field exercise location must be determined prior to class. This location will need to support several burn plots used during the exercises. Students will be divided into groups and act as Fire Investigators and the cadre will act as role players.

- The classroom should be free from outside interruptions and interferences.

- Provide adequate room and flexibility for student work groups and equipment, including supportive facilities such as break areas, restrooms, etc.

- The classroom should have controlled lighting, good acoustics, and good ventilation.

- Provide adequate access to copy and printing services.

- Provide adequate desk space and power outlets for laptop computers (one power strip for each table).

- Be sure a computer with projector and screen is available to show electronic presentations.

- If printing in the classroom, a laptop and driver for the printer will be needed.

Refer to the Course Coordinator's Guide (PMS 907) for more information.

XII. STUDENT ASSESSMENT AND CERTIFICATION

Students must obtain a score of 70% or higher on the student assessment evaluation method chosen to receive a certificate of completion for the course. The final written examination is worth a total of 50 points. The final score for the course will be calculated by dividing the total points scored on the practical and written exams, divided by the total points possible (125 points possible).

A. Practical Exercises

The practical exercises must be delivered in their entirety over the course of the five days (example course agenda on located in Appendix A). The exercises are used as a barometer for the instructor and students to determine if the information presented is accomplishing the desired results. These are ungraded, but should be used by the instructor to reinforce learning objectives.

B. Practical Examinations

There are two practical examinations in this class. Students need to achieve a score of 70 percent on each of the two practical examinations for a passing grade. The field practical examination will be graded using the Practical Examination Team Assessment Checklist and is worth a total of 25 points. The classroom individual practical examination will be graded based on the corresponding answer key, which are found in Appendix C. This classroom practical exam is worth a total of 50 points.

Students should be told at the beginning of the course that the classroom practical examination on the last day of the course will be an individual effort which requires them to successfully identify twenty-five fire pattern indicators from a group of slides. Failure of this practical examination will result in a failure of the course.

C. Final Exam

The final exam and answer key are in Appendix C.

UNIT OVERVIEW

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 0 - Introduction

Time 1 Hour

Objectives

At the completion of the course, the student will have the necessary information to:

1. Perform the common roles and responsibilities of a Wildland Fire Investigator (INVF) involved in an initial investigation environment.

2. Practice wildland fire investigation methods, evidence collection, and documentation processes in a realistic environment.

3. Identify the laws, regulations, and related court procedures associated with administrative, civil, and criminal litigation processes.

4. Describe the fundamentals of investigation.

5. Know the elements of professional code of ethics.

Instructional Method(s)

- Informal lecture
- Classroom discussion
- Interactive group discussion

Instructional Aids

- ☐ Computer with projector, screen, and presentation software
- ☐ Sign-in sheet
- ☐ Flip charts and markers

0.2

UNIT PRESENTATION

Course Wildland Fire Origin and Cause Determination, FI-210

Unit 0 – Introduction

OUTLINE	AIDS & CUES
Present NWCG Training Branch Mission. Present course title slide	00-01-FI210-EP 00-02-FI210-EP
I. WELCOME AND INTRODUCTIONS	00-03-FI210-EP
Introduce course coordinator, instructors, and students. Use any method desired for introductions. Have students provide the following information: • Name and job title • Agency and home unit • ICS qualifications • Experience relative to the position as either a trainee or a trainer/coach, both positive and negative.	

OUTLINE	AIDS & CUES

Note: Instructor should go over the course agenda and discuss the timeframes, teaching process and field exercises.

Discuss the pre-course work. The pre-course work served as a tool to give students a chance to prepare for processes and information that will be presented during the course.

Questions concerning the pre-course work will be answered as the subject matter is addressed during the course.

II. ADMINISTRATIVE CONCERNS

Discuss the following as appropriate:

- Transportation
- Meal schedule
- Course hours
- Breaks
- Tobacco policy
- Local information
- Turn off cell phones, radios, pagers, computers
- Sign-in sheet

Circulate the class registration form or a sign-in sheet for students to sign.

OUTLINE	AIDS & CUES
III. COURSE OVERVIEW	00-04-FI210-EP
A. Course Intent • Provide information to guide the investigator, and to develop critical thinking skills as applied to wildfire investigations. • Every wildland fire investigation is unique. These guidelines are not meant to be all inclusive or to exclude other investigative techniques. • Portions of this course may not apply to every wildland fire investigation. • Policy, time, assignment and resources may dictate the scope and extent to which these guidelines may be applied to a specific investigation. • While this course provides guidelines for the investigator, a systematic approach should be applied to wildland fire investigations. This course is designed to meet the training needs of Wildland Fire Investigator, INVF, as outlined in the Wildland Fire Qualifications System Guide (PMS 310-1) and the position task book developed for the position.	

OUTLINE	AIDS & CUES
B. Course Objectives At the successful completion of this course, students will be able to: 1. Perform the common roles and responsibilities of a Wildland Fire Investigator (INVF) involved in an initial investigation environment. 2. Practice wildland fire investigation methods, evidence collection, and documentation processes in a realistic environment. 3. Identify the laws, regulations, and related court procedures associated with administrative, civil, and criminal litigation processes. 4. Describe the fundamentals of investigation. 5. Know the elements of professional code of ethics. Practical Exercises: • There will be three practical exercises and two practical examinations: • Instructors will demonstrate how the exercises work. • The three practice exercises are ungraded so students can learn the process.	00-05-FI210-EP

OUTLINE	AIDS & CUES

The practical examinations will consist of a group exercise graded by the cadre and an individual fire pattern indicators exercise, also graded by a cadre member.

To satisfy the course objectives, the student will be required to participate in the entire course and complete all exercises and assignments.

C. Grading Values

- Field Practical Exam: 25 points (70% min. score).
- Classroom Practical Exam: 50 points (70% min. score).
- Final written exam: 50 points (70% min. score).
- Final score calculated by adding total points earned by the total possible points of 125.

Stress to the students that a passing score of 70% on each of the final practical exams and the final written exam is required for course passing. Stress the importance of making sure the students learn to identify the fire pattern indicators prior to the last day exam.

Course Evaluation: Students will be given the opportunity to evaluate the instructors and the course. The evaluation forms will be collected at the end of the course.

OUTLINE	AIDS & CUES
D. Wildland Fire Investigator Certification: A National Initiative 1. Proposed to the National Wildfire Coordinating Group (NWCG) in 2000. 2. Wildland Fire Investigation Working Team (WFIWT) established. 3. NWCG Reorganization resulted in Working Team becoming the Wildland Fire Investigation Subcommittee (WFISC).	00-06-FI210-EP
E. Wildland Fire Investigation Subcommittee The WFISC is responsible for the creation and maintenance of the fire investigation courses. This includes FI-110, FI-210, FI-310 and FI-"311" (the civil course still in development). The subcommittee is comprised of voting members and subject matter experts (SMEs). The voting members are those representatives from the NWCG member agencies. SMEs include representatives from non-NWCG agencies from the United States, Canada, New Zealand, and Australia, retired agency personnel, and private contractors. The WFISC is made up of representatives from: • USDA-Forest Service • Oregon Department of Forestry	00-07-FI210-EP

OUTLINE	AIDS & CUES
• USDOI-Bureau of Land Management	
• Minnesota Department of Natural Resources	
• USDOI-Bureau of Indian Affairs	
• Federal Law Enforcement Training Center (FLETC)	
• USDOI-Fish and Wildlife Service	
• USDOJ-Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF)	
• West Virginia Division of Forestry	
• USDOI-National Park Service	00-08-FI210-EP
• California Department of Forestry and Fire Protection (CalFire)	
• Saskatchewan Environmental Resources Ministry	
• Alberta Forest Protection Division	
• Australia, Australian Capital Territory RFS	
• Australia, Victoria CFA	
• New Zealand RFA	
• British Columbia Ministry of Forests	

OUTLINE	AIDS & CUES
F. Wildland Fire Investigation Course Development	00-09-FI210-EP
• Development approved by NWCG Board in October 2001.	
• Draft developed.	
• National peer review – 160 written comments	
• Revised draft approved by NWCG.	
• Originally released in 2005.	
• Course revised in 2015.	
1. Certification Process	00-10-FI210-EP
• Understand the requirements for agency certification.	
• PMS 310-1 (Wildland Fire Qualifications System Guide)	00-11-FI210-EP
• Two levels of Wildland Fire Investigator certification: – INVF: Origin and Cause – INTM: Investigation Team Member	
• Minimum skills/knowledge: – Fire behavior. – Fire ignition sources and factors.	00-12-FI210-EP

OUTLINE	AIDS & CUES
– Fire pattern interpretation. – Investigation methodology and techniques.	
2. Wildland Fire Investigator Certification Standards – INVF: Origin and Cause • FI-210 training. • Position task book and proficiency exercises.	00-13-FI210-EP
Note: Most agencies require task book completion for certification as an INVF or INTM. The US Forest Service does not require a task book for LEI personnel for INVF certification.	
• Recommended training: – I-100/200, S-130, S-190, S-290, FI-110 • Employing agency certification.	

OUTLINE	AIDS & CUES
3. Wildland Fire Investigator Certification – INTM: Investigation Team Member • Minimum skills – Intermediate fire behavior. – Complex origin and cause. – Managing investigation team. – Enhanced knowledge of civil and criminal processes. – Arson investigation. – Investigation methodologies beyond the preliminary level.	00-14-FI210-EP
G. Fire Investigation • Wildland fire investigation is a blend of skills. – Fire service – Law enforcement • To effectively investigate a wildland fire, a team approach is encouraged.	00-15-FI210-EP

OUTLINE	AIDS & CUES
• Cooperation, when appropriate, increases the effectiveness of the investigation.	
1. The fundamentals of investigation	00-16-FI210-EP
• Definition of an investigation.	
• Components of an investigation.	
• Relationship of an investigation to litigation.	
a. What is an investigation?	00-17-FI210-EP
• Application of a systematic approach of examination.	
• Factual documentation.	
• Interaction with people.	
• Assessing physical objects.	
• Applied through technical skills and science.	

OUTLINE	AIDS & CUES
b. Objectives of an investigation. • Identify: – Who – What – When – Where – How – Why	00-18-FI210-EP
H. Professional Ethics • Conduct investigations consistent with professional practices. • Investigate in an unbiased manner. • Avoid/report conflict of interest. • Maintain confidentiality and investigative integrity.	00-19-FI210-EP
I. Professional Performance • Identify and mitigate hazards. • Work in a safe manner. • Follow agency policy. • Protect the area of origin.	00-20-FI210-EP

OUTLINE	AIDS & CUES
Note: The term "area of origin" for the purpose of this course includes the general origin area and the area outside the general origin area, sometimes referred to as the evidence protection area.	
• Cooperate with other investigating agencies.	
• Keep your supervisor informed.	
• Request assistance if needed.	00-21-FI210-EP
• Conduct a thorough examination of the scene.	
• Identify, document, collect and preserve evidence.	
• Identify, interview and treat all parties fairly and with respect.	00-22-FI210-EP
• Make prompt referrals to other authorities or agencies.	
• Identify follow-up actions.	
• Self-discipline to fully complete the documentation and reports in a timely manner.	

OUTLINE	AIDS & CUES
1. Local area knowledge	00-23-FI210-EP
• Road systems	
• People	
• Use patterns	
• Fire history	
• Weather patterns	
2. Local Fire Behavior	00-24-FI210-EP
• Burning conditions	
• Fuels	
• Fire indicators	
3. Sources of additional expertise	
• Other investigators	
• Accelerant detection and/or tracking K9	
• Electrical engineers	
• Metallurgists	

OUTLINE	AIDS & CUES
4. Training first responders (FI-110).	00-25-FI210-EP
Note: This FI-110 training will increase your chances of determining origin and cause. FI-110 training has been shown to increase the awareness of initial responders and result in greater scene protection, witness identification, and evidence protection.	
• Observation skills	
• Origin protection	
• Witness identification	
• Evidence protection	
J. Safety On Wildland Fire Investigations	00-26-FI210-EP
Work site hazards:	
• Hostile subjects	
• Tanker drops	
• Beetle kill trees/snags	
• Tree on power line	
• Stump holes	
• Downed power lines	
• Peat moss	
• Railroads	
• Vehicular traffic	

OUTLINE	AIDS & CUES

- Bad weather
- Wildlife

Note: As a wildland fire investigator you may be dispatched to various types of fire scenes. During the course of an investigation, investigator safety is paramount. You may encounter many different work site hazards, some examples are:

- Hostile subjects, i.e., arsonists.
- Tanker drops – talk about safety if you are caught in a tanker drop. Bird Dog siren (Canada) – this means there's a tanker drop coming soon.
- Snags – as a wildfire investigator, you will be working in an area where fire has burned through this area, therefore root systems of trees are weakened, snags are ready to fall down in the wind, etc. Stress need to wear hard hat.
- Tree on power line – use the "2 power pole rule"—stay away at least 2 power poles distance. Don't remove the tree yourself; get the utility company to do this.
- Downed power line – always assume it's live. Wait for power officials to declare it officially turned off.

OUTLINE	AIDS & CUES
• Peat moss – holes are burned deep into peat moss, so be careful not to fall into these locations.	
• Railroads – locomotives traveling through fire scene; also safety in the railway yard.	
• Vehicular traffic – in your career you will investigate fires beside roadways, so look out for erratic drivers who are looking at the fire suppression or emergency vehicle activities and are not paying attention to where they are going; also smoky conditions, etc.	
• Booby traps (e.g., marijuana grow ops)	00-27-FI210-EP
• Illegal drug production dump sites (HAZMAT)	
• Steep terrain (rolling rocks and debris)	
• Snakes	
• Stinging/biting insects (bees, wasps, mosquitoes)	
• Illegal drug production dump sites (i.e., meth labs)	
• Steep terrain – best to work with partner, and be aware of rolling rocks and debris.	

OUTLINE	AIDS & CUES
• Snakes. Take precautionary measures. • Viruses, i.e., West Nile. Use bug spray. • Fire Incident Command -**important to notify fire personnel of your presence at the fire scene so they know you are in the area. • Hazards in coal bed methane fields, Hydrogen Sulfide (H2S)	
Note: H2S gas is a serious concern in parts of the western U.S. where methane wells are active.	
1. Benzene • Also called Sour Gas. • Toxic, colorless gas. • 21% heavier than air. • In low concentrations, has odor of rotten eggs. • Deadens sense of smell and is flammable in higher concentrations. • Could be present near well sites or in low lying areas.	00-28-FI210-EP

OUTLINE	AIDS & CUES
• Recognition of Symptoms – Hydrogen Sulfide (H2S) – Potentially deadly at concentrations above 100 PPM. Symptoms include: • Eye irritation • Dryness/irritation of throat • Irritation of respiratory system • Loss of sense of smell • Headache • Nausea	00-29-FI210-EP

Note: Hydrogen sulfide is extremely dangerous and lethal. Pockets of H_2S occur naturally underground in coalbed methane areas. The gas surfaces, generally in small amounts and is noticeable by the "rotten egg" odor. Because H_2S deadens the sense of smell you may notice the rotten egg smell at first then the odor may "disappear". The odor is still there, but your sense of smell is deadened, so you will not be aware of a possibly lethal concentration of H_2S gas.

OUTLINE	AIDS & CUES
2. METHANE (CH4) • Colorless • Odorless • 40% lighter than air. • Principle component of natural gas. • Flammable in higher concentrations. • Naturally occurring in seeps and vents.	00-30-FI210-EP
a. Recognition of Symptoms – Methane (CH4) • Lighter than air so exposure is typically not an issue. • Main hazard is its flammability. • Can cause explosion in high concentrations (typically those found only in confined spaces).	00-31-FI210-EP

OUTLINE	AIDS & CUES
• Be aware that in rare situations a vehicle could act as a confined space. – Use caution before entering a vehicle by airing out if prolonged exposure has occurred.	
IV. SAFETY ON WILDLAND FIRE INVESTIGATIONS	00-32-FI210-EP
• **Safety will be stressed throughout this course.** • Agency requirements for Personal Protective Equipment (PPE) vary. • **Investigations should follow agency PPE** policy.	

OUTLINE	AIDS & CUES
V. UNIT 0 – SUMMARY • Certification and additional training. – INVF/INTM – Position Task Books – Agency certification • Fundamentals of an investigation. – Teamwork – Systematic approach • Professional ethics and performance. – Safety – Follow agency policy	00-33-FI210-EP
Ask students if they have any questions concerning the Wildland Fire Incident Management Field Guide, PTB, or requirements for passing this class.	
Review course objectives. Answer students' questions.	

UNIT OVERVIEW

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 1 – Fire Pattern Indicators

Lesson 1A – Fire Patterns – Introduction

Time 1.5 Hours

Objectives

1. Describe the effects of fire on combustible and non-combustible objects.
2. Describe and classify the various fire pattern indicator categories.
3. Correctly assess vectors within the various fire pattern indicator categories.
4. Explain the underlying fire science principles that govern fire initiation and progression.
5. Apply a systematic methodology and use the various indicators to trace fire progression back to the specific origin area and ignition area.
6. Describe the general appearance of the fire pattern indicator.
7. Explain the fire behavior behind its formation.
8. List general reliability and potential exceptions.
9. Describe characteristics for each vector category within an indicator class.

Strategy

This unit is designed to provide a basic understanding of how fire behavior impacts the creation of fire effects which in turn create fire pattern indicators

Instructional Method(s)

- Informal lecture
- Classroom discussion

Instructional Aids

- ☐ Computer with projector, screen, and presentation software
- ☐ Sign-in sheet
- ☐ Flip charts and markers

Exercise(s)

- This unit will be followed by a field exercise on the afternoon of the second day of class which incorporates the lessons taught in this unit.

UNIT PRESENTATION

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 1– Fire Pattern Indicators

Lesson 1A – Fire Patterns – Introduction

OUTLINE	AIDS & CUES
Present unit title slide.	1A-01-FI210-EP
PRESENT UNIT OBJECTIVES.	1A-02-FI210-EP
1. Describe the effects of fire on combustible and non-combustible objects.	
2. Describe and classify the various fire pattern indicator categories.	
3. Correctly assess vectors within the various fire pattern indicator categories.	
4. Explain the underlying fire science principles that govern fire initiation and progression.	
5. Apply a systematic methodology and use the various indicators to trace fire progression back to the specific origin area and ignition area.	1A-03-FI210-EP
6. Describe the general appearance of the fire pattern indicator.	
7. Explain the fire behavior behind its formation.	
8. List general reliability and potential exceptions.	
9. Describe characteristics for each vector category within an indicator class.	

OUTLINE	AIDS & CUES
I. INTRODUCTION	
Determining the origin; How the ignition source came into contact with the materials fire ignited; and identifying the responsible party are the fundamental purposes of a wildland fire investigation.	1A-04-FI210-EP
How do we go from this…	1A-05-FI210-EP
…to this?	1A-06-FI210-EP
By applying a systematic methodology…	1A-07- FI210-EP
…We can read the fire pattern indicators left in the fire's path	1A-08-FI210-EP
…and trace the progression of the fire…	1A-09-FI210-EP
…back to the materials first ignited and the remains of the ignition source.	1A-10-FI210-EP
To do this successfully, we need to correctly interpret the signs a fire leaves.	1A-11-F210-EP
Fire burns according to set scientific principles.	
Evidence of its progress takes the form of fire pattern indicators also referred to as "Fire Effects."	1A-12-FI210-EP

OUTLINE	AIDS & CUES
Note: Recognizing fire patterns is somewhat like looking at those "Magic Eye" posters that were popular in the 1990s. To the untrained eye, a fire scene appears to be nothing but a jumbled and confusing mass of burned material. But once the eye is trained to recognize indicators, "the picture" of how the fire progressed will appear, just as the "picture" in the Magic Eye posters appears, once you learn how to see them.	1A-13-FI210-EP
II. FIRE BEHAVIOR AND FIRE EFFECTS TERMINOLOGY	1A-14-FI210-EP
Note: This section (Slides 15-47) deal with fire behavior and fire effects terminology, not fire pattern indicator categories.	
A. Terminology	1A-15-FI210-EP
The following terms are used in wildland fire investigation. Each will be discussed in detail in the following slides:	
• Fire pattern indicator	
• Fire pattern	1A-16-FI210-EP
• Fire progression	
• Fire vector	
• Advancing fire	
• Backing fire	
• Lateral fire	

OUTLINE	AIDS & CUES
• Transition zone • Macroscale indicator • Microscale indicator • Damage differential • Compare and contrast • Systematic methodology	
Note: Do not discuss each of these individually at this point. They will be discussed in detail later.	
1. Fire Pattern Indicator • A physical object that displays changes (fire effects) from exposure to heat, flame, and combustion byproducts. • Accurate analysis can reveal fire progression at that precise location. • A single component of the overall fire pattern.	1A-17-FI210-EP

OUTLINE	AIDS & CUES
Note: "Fire effects" are the observable or measurable changes in or on a material as the result of a fire. Fire effects has a similar but broader meaning in the context of prescribed fire, *(The physical, biological, and ecological impacts of fire on the environment),* but in fire investigation it refers to the specific changes that are caused to a combustible or non-combustible object when it is exposed to heat and/or the byproducts of combustion. Indicators that are in disagreement with the majority of indicators in an area used to be called "false indicators," but they are not false, only representing fire progression at that precise point, which may not be reflective of overall fire progression.	
2. Fire Pattern • Analyzing the relationship of the <u>majority</u> of individual indicators reveals the overall fire pattern. • This in turn will reveal overall fire progression.	1A-18-FI210-EP
3. Fire Progression • Most fires start small. – Smoldering, glowing ignition • Ultimately transitions to flaming ignition.	1A-19-FI-210-EP

OUTLINE	AIDS & CUES
• Burns in all directions until influenced by: – Wind – Slope – Fuel – Suppression – Or combination of the above.	
• Once influenced, the fire will progress outward.	1A-20-FI210-EP
• Vector areas will become established.	
Note: Direction and intensity will be dictated by wind, slope and/or fuels.	
4. Fire Pattern Indicator Vectors	1A-21-FI210-EP
• Physical characteristics of an indicator that show direction of fire progression.	
• Define fire spread based on direction.	
• Identify transition zones.	
• Often subtle	
Note: Slide depicts and advancing fire vector.	1A-22-FI210-EP

OUTLINE	AIDS & CUES
• Three vector areas based on the dynamics of fire spread. – Head: *advancing* – Flanks: *lateral* – Heel: *backing*	
5. Advancing Fire Vector • Rapid fire spread – Head fire – Forward run • Higher intensity • Increased flame length • More damage • Macroscale indicators • Recommended diagramming symbol: red arrow pointed in direction of fire spread.	1A-23FI210-EP
6. Backing Fire Vector • Slower rate of spread – Against wind – Down slope • Lower intensity	1A-24-FI210-EP

OUTLINE	AIDS & CUES
• Lower flame length • Less damage • Microscale indicators • Recommended diagramming symbol: blue “U” with bottom of “U” pointed in the direction of the backing fire.	
Note: The bottom of the “U” and the point of the “V” need to point in the direction of the fire spread.	
7. Lateral Fire Vector • Rate of spread and intensity between advancing and backing. - Flank fire - Spread lateral to main fire • Indicators can have characteristics of backing or advancing, depending on fire behavior circumstances. • Recommended diagramming symbol: Yellow “V” or triangle.	1A-25-FI210-EP

OUTLINE	AIDS & CUES
Note: The point of the yellow "V" needs to point in the direction of the fire spread. Be careful using the solid yellow marker on drawings –it must have a clear dominant triangle point (direction).	
a. Lateral Fire Patterns and Indicators • A higher intensity flank may leave indicators consistent with advancing fire spread: – Exhibits a more defined and narrower transition zone. • A lower intensity flank may leave backing-type indicators: – Exhibits a more subtle and wider transition zone. • Intensity on flanks may change with wind/slope/fuels.	1A-26-FI210-EP
Note: Exposed side is generally oriented towards the origin. Unexposed side generally oriented away from the origin.	

OUTLINE	AIDS & CUES
b. Heat/Flame Exposure Lateral Indicators • Sooting, staining, and white ash deposits appear on the exposed side. • Protection indicators will appear on the non-exposed side. • Generally 45° to 90° angle to the direction of advancing fire spread.	1A-27-FI210-EP
Note: Exposed side is generally oriented towards the origin. Unexposed side generally oriented away from the origin.	
Note: Main advance was in direction of the red arrow. The heat exposure lateral indicator is the charring and protection behind the limb in the upper part of the slide and it is at an approximate 45 degree angle to the main fire progression.	1A-28-FI210EP
c. Wind Influenced Lateral Indicators • Foliage freeze, grass stem, cupping, white ash deposits, and angle of char. • Generally appear on the exposed side of the object.	1A-29-FI210-EP

OUTLINE	AIDS & CUES
• Usually aligned with advancing fire pattern indicators: – May be at 45° angle to advancing spread. • Grass stems are intensity dependent: – May fall into the burned area at 45° to 90° angle and remain on ground. – May be consumed completely.	
Note: Foliage freeze, cupping, white ash deposit, and angle of char on the flanks will typically be in alignment with the wind. Exception: high wind vortex flame wrap.	
Note: Wind influenced lateral indicators will align mostly with the direction the wind is blowing, up to about a 45 degree angle from the direction the main advancing fire is progressing.	1A-30-FI210-EP

OUTLINE	AIDS & CUES
For example, foliage freeze will generally be in line with the foliage freeze in the advancing zones; grass stem indicators along the flanks will typically fall into the already burned lateral zone with the stem heads facing back to the origin area at an approximate 45 degree angle; angle of char on the flanks will present between direct alignment with the angle of char indicators in the advancing zone and out to about a 45 degree angle to the main direction of the advancing zone. Cupping and white ash indicators will be similar. In the photograph, the small trees in both the advancing area on the left and the lateral areas on the right exhibit identical angle of char indicators on the crowns and foliage freeze indicators on the needles. The only difference is in the intensity, with the advancing area showing more crown consumption, while the lateral area is simply scorched.	
d. Lateral Fire Patterns and Indicators • Flanks defined by strips of unburned or partially burned fuel. • Influenced by change in wind and slope.	1A-31-FI210-EP

OUTLINE	AIDS & CUES
Note: Slide shows the origin area of the Jasper Fire, largest fire in the history of the Black Hills (at the time in 2000). Fire was deliberately ignited by Janice Stevenson just above the dirt road. The fire's main run was uphill to the upper right of the photograph; however the wind was not blowing consistently, but was varying back and forth with about a 20 degree variation. The wind changes caused the flanks to vary in intensity, with one flank burning hotter, then the other flank burning hotter wind the wind switched. The effect of this wind change left strips of less burned areas along the flanks as the wind varied back and forth.	
8. Transition Zone • Area of <u>directional</u> change based on variations in intensity. - Advancing to lateral. - Advancing to backing. - Backing to lateral. • Change in appearance and characteristics of fire pattern indicators. • Transition zones may outline specific origin area. • A key to accurately interpreting fire patterns is identifying transition zones.	1A-32-FI210-EP

OUTLINE	AIDS & CUES
Note: Emphasize transition zones in different areas in this slide of Anatomy of a Wildfire.	1A-33-FI210-EP
Note: Emphasize transition zones in different areas. Can you identify the transition zone?	1A-34-FI210-EP
Note: Transition zone often is displayed by a change in the fuel consumption or degree of damage. In this slide, the orange triange area shows the transition zone from almost complete consumption of the grass stems on the right side of the photo and the remains of less consumed grass stems to the left side of the transition zone.	
Note: This slide is animated through the phases of the fire**.**	1A-35-FI210-EP
Note: This slide is animated through the phases of the fire**.**	1A-36-FI210-EP
Note: This slide is animated through the phases of the fire**.**	1A-37-FI210-EP
B. Fire Pattern Indicator Categories • 11 categories • Based on fire behavior and materials. • Exhibits one of the three vectors: – Advancing	1A-38-FI210-EP

OUTLINE	AIDS & CUES
– Lateral – Backing • Physical appearance differs with vector. – Direction of fire progression.	
Note: There used to be 14 categories in previous version of FI-210, now are only 11.	
The two categories of depth of char and damage differential are sub categories of protection category. Die-out was also removed as it was only a reflection of fire intensity and not truly an indicator in and of itself**.**	
1. Macroscale Fire Pattern Indicators • Usually associated with larger objects or areas. • Easily visible from a distance. • Usually higher intensity. • Commonly defines areas of advancing fire.	1A-39-FI210-EP
Note: Ponderosa pine tree in slide showing angle of char to crown of tree	

OUTLINE	AIDS & CUES
2. Microscale Fire Pattern Indicators • Associated with smaller objects or areas. • May not be as easily observed from a distance. • Importance increases with proximity to the origin.	1A-40-FI210-EP
Note: May be more subtle than macroscale indicators. These indicators generally need to be observed from a close up position (kneeling, squatting, hands and knees position), not generally from a standing position.	
3. Fire Pattern Indicator Clusters • Consistent vectors. • Variety of indicator categories = greater reliability. • In close proximity to each other.	1A-41-FI210-EP
Note: Close proximity: relative based on the indicators, such as five trees in a cluster. The distance between the indicators in a cluster draws closer as you near the ignition area. Macro scale clusters tend to have greater spacing than micro scale clusters.	
Note: Example of indicator cluster	1A-42-FI210-EP

OUTLINE	AIDS & CUES
4. Damage Differential • Underlying principle that governs interpretation of most fire pattern indicators. – Individual indicators. – Larger areas (V and U pattern). • Change that occurs to combustible and non-combustible objects after interaction with fire • Amount of change will be based on relative fire intensities • Compare and contrast damage differential	1A-43-FI210-EP
Note: Damage differential is a principle, not an "indicator."	
5. Damage Differential, Compare and Contrast • Possible characteristics to compare and contrast: – Amount of charring. – Amount of white ash.	1A-44-FI210-EP

OUTLINE	AIDS & CUES
– Degree of loss of material. – Amount of sooting/staining. – Height and type of foliage freezing. – Degree and location of spalling. – Height and type of angle of char. – Location and extent of cupping. – Location and relative extent of general fire damage over larger area.	
Note: Degree of loss of material is on an individual item.	1A-45-FI210-EP
– Same size. – Same category. – Separate locations. – Based on comparing and contrasting amount of damage.	
Note: Compare multiple similar items as described in the slide. Can you identify the transition zone?	1A-46-FI210-EP

OUTLINE	AIDS & CUES
Note: The area to the right contained saplings and resembled the area to the left prior to the fire, but the saplings to the right were more fully consumed by the higher intensity advancing fire.	
III. GENERAL PRINCIPLES OF FIRE PATTERN INTERPRETATION	1A-47-FI210-EP
Note: These general principles have been around for many years. First known documentation was by Bob Bourhill of Oregon Dept. of Forestry, and author of "A Guide to Natural Cover Wildfire Fire Direction Indicators. (1982)"	
• Base your interpretation on the majority of the fire pattern indicators within an indicator category.	1A-48-FI210-EP
– Single indicators may be unreliable in the context of overall fire progression.	
– Reflects fire direction at a precise point.	
• Base your interpretation on the fire pattern indicators within a variety of categories.	1A-49-FI210-EP
– 11 categories.	
– Use as many categories as possible.	
– Systematic method	

OUTLINE	AIDS & CUES
• A single indicator may be accurate within a 180° arc. – Fire does not burn in perfectly straight line. – Radical but brief directional changes. – Progression based on fuels, wind, and/or slope. – Fire pattern indicators align with progression	1A-50-FI210-EP
Note: White circle is around cigarette match device.	
Example of primary fire direction, backing vector.	1A-51-FI210-EP
• Interpret fire pattern indicators within the context of fire behavior principles. – Determine fire behavior context through: o Weather observations o Topography • Reconstruct probable fuel conditions based on: – Unburned fuels – Burned remains	1A-52-FI210-EP

OUTLINE	AIDS & CUES
• Interview witnesses – First responders – Civilian witnesses	1A-53-FI210-EP
Note: When taking witness statements or conducting interviews follow agency policy.	
• Fire pattern indicators will usually become less pronounced as you approach the ignition area. – Most fires start small. – Intensity usually increases as fire progresses. – Microscale indicators may be subtle.	1A-54-FI210-EP
• Avoid attempts to prematurely locate the ignition area. – Fire pattern indicators become increasingly subtle the closer you get to the ignition area. – Pay closer attention to detail. – Avoid the pressure to rush. – Patience is the key.	1A-55-FI210-EP
Where would you put the specific origin area?	1A-56-FI210-EP

OUTLINE	AIDS & CUES
Note: Final graphic (circle) appears on advancement of the slide.	1A-57-FI-210-EP
• Direction of fire travel will be influenced by obstacles.	
– Around and/or over	
– Loss of intensity and speed.	
– Temporary direction change.	
Note: Fluid movement of fire is similar to fluid movement of water around obstacles.	
– Obstacles will slow and alter the direction and intensity of fire spread.	1A-58-FI210-EP
Note: This slide is animated – wait for it.	
Answer students' questions.	

UNIT OVERVIEW

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 1 – Fire Pattern Indicators

Lesson 1B – Fire Behavior Indicator Categories

Time 3 Hours

Objectives

1. Describe the effects of fire on combustible and non-combustible objects.
2. Describe and classify the various fire pattern indicator categories.
3. Correctly assess vectors within the various fire pattern indicator categories.
4. Explain the underlying fire science principles that govern fire initiation and progression.
5. Apply a systematic methodology and use the various indicators to trace fire progression back to the specific origin area and ignition area.
6. Describe the general appearance of the fire pattern indicator.
7. Explain the fire behavior behind its formation.
8. List general reliability and potential exceptions.
9. Describe characteristics for each vector category within an indicator class.

Instructional Method(s)

- Informal lecture
- Classroom discussion

Instructional Aids

- ☐ Computer with projector, screen, and presentation software
- ☐ Sign-in sheet
- ☐ Flip charts and markers

UNIT PRESENTATION

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 1 – Fire Pattern Indicators

Lesson 1B – Fire Behavior Indicator Categories

OUTLINE	AIDS & CUES
Present unit title slide.	1B-01-FI210-EP
I. INTRODUCTION	1B-02-FI210-EP
• Discuss in detail each of the 11 categories. – Description and general appearance. – Fire behavior behind formation. – General reliability and possible exceptions.	
• Examine each fire pattern indicator within the three vector areas. – Advancing. – Backing. – Lateral (where applicable).	

OUTLINE	AIDS & CUES
II. FIRE PATTERN INDICATOR CATEGORIES 1. Protection 2. Grass Stem 3. Foliage Freeze 4. Angle Of Char 5. Spalling 6. Curling 7. Sooting 8. Staining 9. White Ash 10. Cupping 11. V/U Patterns	1B-03-FI210-EP

Note: Do not attempt to explain these categories at this time. This represents a change from 14 categories to 11 categories. The "categories" of die out, depth of char and degree of damage were removed because they are not "categories." This represents a change from the first version of FI-210 (2005).

OUTLINE	AIDS & CUES
Revised Indicator Category List Currently there are 11 categories, reduced from 14. Note: This change occurred with the 2016 revision of FI-210. Categories revised: • Die-out – Tends to reflect fire intensity rather than direction. • Depth of char – Added as a sub-category of protection. • Degree of damage. – Recognized in this course as a component of protection: essentially the obverse side of protection. – Side of an object exposed to the fire effects/side not exposed to fire effects.	1B-04-FI210-EP
General reliability and possible exceptions: • Indicators accurately reflect fire behavior. • A single vector may not be consistent with general fire progression. • Fire pattern indicators should be tested to determine reliability.	1B-05-FI210-EP

OUTLINE	AIDS & CUES
Note: Indicators should be analyzed/tested to determine their reliability. Under certain circumstances, indicators may be misleading if not correctly interpreted. Indicators accurately reflect fire behavior at that particular place and time the fire passed, however the vector displayed may not be consistent with general fire progression. Investigator must be familiar with the fire behavior conditions that may cause an indicator to be inconsistent with other indicators. Other circumstances can occur that create possible exceptions that only apply to a specific indicator category. These will be addressed in each specific indicator category.	
• Certain circumstances occur that create possible exceptions that apply to most indicator categories.	1B-06-FI210-EP
• Other circumstances may occur creating possible exceptions that only apply to a specific fire pattern indicator category. – These will be addressed in each specific indicator category.	
• Heavy or uneven fuel loading	1B-07-FI210-EP
• Long-term fire residence	
• High winds	

OUTLINE	AIDS & CUES
• Directional wind changes • Fire backing downslope against wind • Variation in sound and rotten fuel • Indicators that may have been moved. • Previous fires in same area/reburns. May apply to most fire pattern indicator categories. Note: Heavy fuel loading/long-term fire residence. • May cause damage to be equally distributed. Uneven fuel loading. • May cause more damage where the fuel is heaviest, which may be on the non-origin side of an object. High winds. • May cause vortex flame wrap on vertical fuels.	
<u>General reliability and possible exceptions</u> (cont.) Assess fire pattern indicators for reliability. • Indicator consistent with: – Fire behavior context. – Other indicators within a nearby pattern cluster. – Generally known fire progression.	1B-08-FI210-EP

OUTLINE	AIDS & CUES
– Eye witness observations. – Video or photo evidence. • Did any of the circumstances that can create exceptions exist during the fire's initial stages? – Test the reliability of fire pattern indicators with these exceptions in mind. We will now examine each individual category: 1. Description 2. Fire behavior 3. Specific reliability and possible exceptions unique to the category. 4. By vector and by macroscale and microscale, where applicable.	1B-09-FI210-EP
1. Protection Indicators: Description: • Objects are less damaged in appearance on the non-exposed side. • The same object is more damaged on the exposed side.	1B-10-FI210-EP
Note: Explain exposed vs. non-exposed surface.	1B-11-FI210-EP
Note: Protection indicator, more damaged vs. less damaged.	

OUTLINE	AIDS & CUES
• Identified by: – Less charring. – Less staining and sooting. – Less white ash. – Clean burn lines under the object on the unprotected side of fuels.	1B-12-FI210-EP
• Compare and contrast most damaged side to least damaged side.	
Lift and remove objects laying on the ground *(After first photographing them in place).*	1B-13-FI210-EP 1B-14-FI210-EP 1B-15-FI210-EP
<u>Protection Indicators: Description</u> (cont.)	1B-16-FI210-EP
• Object shields fuels from heat and flame. • Both combustible and non-combustible objects. • Same object may shield itself on non-exposed side.	
<u>General Reliability and Possible Exceptions – Protection</u>	1B-17-FI210-EP
• Accurately shows fire direction. • Low to moderate intensity fires most reliable. • Possible exceptions: – Pithy stalks – Suspended fuel	

OUTLINE	AIDS & CUES
• Damage may be on the opposing side or equally distributed on both sides under above conditions.	
• Pithy stalks: a vascular plant that has a usually continuous central internal strand of spongy tissue in the stem.	1B-18-FI210-EP
• May be annual or perennial.	
• Because the outer sheathing is very thin, it may burn through on the non-exposed side due to flame wrap, with the fire becoming embedded in the soft, porous tissue.	
• This may cause more damage on the non-exposed side of the stem.	
Example of pithy stalk.	1B-19-FI210-EP
<u>Suspended Fuels:</u>	1B-20-FI210-EP 1B-21-FI210-EP 1B-22-FI210-EP 1B-23-FI210-EP
• Limbs and tree trunks may be suspended by other fuels or objects such as rocks.	
• Gap between the fuel and the ground causes vortex flame wrap on the non-exposed side of the object, creating more damage and leaving protection on the exposed side.	
• It may appear that the fire came from the opposite direction, especially if the object falls to the ground after the fire has passed.	

OUTLINE	AIDS & CUES
<u>Advancing Fire, Macroscale Fire Pattern Indicators – Protection</u> • Clearer on larger objects. • On smaller objects may be difficult to discern due to entire object being charred. • Difference from exposed side to non-exposed side can still be determined (compare and contrast). Note: The stump shown in this example is larger diameter than is recommended for using as a protection indicator.	1B-24-FI210-EP
<u>Advancing Fire Microscale Fire Pattern Indicators – Protection</u> • Used to validate macroscale fire patterns. • Use when macroscale fire patterns do not exist. • Pattern clusters	1B-25-FI210-EP
• Fuels shielded from damage on non-exposed side: – Downed logs and tree limbs – Foliage crowns – Pine cones – Grass clumps	1B-26-FI210-EP

OUTLINE	AIDS & CUES
– Small stumps – Brush – Deer/rabbit pellets	
Note: Slide shows small pine sapling with more burn damage on the left side than on the right as seen in more char and less needle material left on left side	1B-27-FI210-EP
Note: Grass shows more damage/char to the right side than on the left side as shown by longer stems and green regrowth where it was protected by the grass stems on its right	1B-28-FI-210-EP
Note: Compare and contrast damage on opposite sides of the bottle, rock, etc. Emphasize to the students to lift objects up to view the opposing	1B-29-FI210-EP 1B-30-FI210-EP
<u>Backing Microscale Fire Pattern Indicators – Protection</u> • Generally more protected fuels in backing area due to lower intensity. • On smaller objects • Non-exposed side	1B-31-FI210-EP
<u>Lateral Macroscale Fire Pattern Indicators – Protection</u> • Damage on side closest to advancing fire front.	1B-32-FI210-EP 1B-33-FI210-EP

OUTLINE	AIDS & CUES
• Presents at 45°- 90° angle to advancing fire progression. • Protection more noticeable when contrasted against advancing area.	
2. Grass Stem Fire Pattern Indicators: Description • Condition of residual stems after fire passes. • Fire intensity controls appearance of remains.	1B-34-FI210-EP 1B-35-FI210-EP
<u>Advancing Grass Stem Fire Pattern Indicators:</u> Description: • Grass remains in advancing area will typically consist of only a small part of the stem base. – These stems may show cupping. • Look for transition zones between backing and lateral.	1B-36-FI210-EP
<u>Typical Advancing Fire with Transition to Backing and Lateral Fire</u> Note: Point out to the students the grass stem remains along the yellow line.	1B-37-FI210-EP

OUTLINE	AIDS & CUES
Grass Stem Indicators: Description-Backing/Lateral	1B-38-FI210-EP
• Backing fire weakens the side exposed and stem falls in direction fire came from. – Like undercut on tree. • More reliable on lower intensity fires. • Occurs primarily in backing areas, but may occur in lateral transition zones.	
Note: Reemphasize the base of the "U" faces in the direction of the fire spread.	1B-39-FI210-EP
Grass Stem Transition Zone Patterns Near Origins Grass stems may form recognizable patterns within the specific origin area: • Backing to advancing transition zone. • Lateral transition areas may be outlined with downed stems.	1B-40-FI210-EP
Circle Pattern: • Generally, fire burns away from ignition area equally in all directions. • No wind or slope influence in specific origin area. • Grass stems fall inward toward ignition area and remain relatively intact.	1B-41-FI210-EP 1B-42-FI210-EP

OUTLINE	AIDS & CUES
Note: "U" or "V" grass stem fall pattern.	1B-43-FI210-EP
Note: Circle pattern along edge.	1B-44-FI210-EP
<u>General Reliability and Possible Exceptions – Grass Stems</u> • Grass stem fire pattern indicators are usually very reliable. • Segregate backing from advancing areas. • Define lateral areas. • Possible exceptions: (Exceptions will be covered in the subsequent slides.)	1B-45-FI210-EP
– Exception – Snow mat: may leave stalks in all areas and inconsistent direction.	1B-46-FI210-EP
Note: This is why it is important to examine unburned adjacent areas.	
– Exception – High wind/Steep slope: may consume stalks in all areas. – Exception – Wind throw: may leave stalks in all areas and inconsistent direction. – Exception – Uncured fuel: may leave stalks in all areas and inconsistent direction. – Exception – High Intensity: may consume stalks in all areas of fire progression.	1B-47-FI210-EP

OUTLINE	AIDS & CUES
Note: Grass stems that have fallen in the same direction due to high winds may not be reliable as a directional indicator but the amount of grass stem remains can be used to help determine transition areas.	
<u>Advancing Fire Macroscale Patterns – Grass Stem</u> • Stems burned off at base. • No heads or stalks. – Heads or stalks may outline lateral areas. • "Clean" burn. • May form V or U shape.	1B-48-FI210-EP
<u>Advancing Microscale Fire Pattern Indicators – Grass Stem</u> • Lack of residual stems. • Stems and clumps burned off at/near base. • Angle steeper than slope on clumps. • Individual stems sharp/pointed on the non-exposed side.	1B-49-FI210-EP
Note: Clumps of bunch grass in slide.	

OUTLINE	AIDS & CUES
Backing Macroscale Patterns – Grass Stem • Littering of unburned/partially burned grass stems/seed heads. • Majority of stems/seed heads will point in the direction the fire came from.	1B-50-FI210-EP
Note: Grass seed heads point in direction fire came from.	1B-51-FI210-EP
Backing Microscale Fire Pattern Indicators – Grass Stem • Individual head and stems point in the direction the fire came from. • Remember 180° rule.	1B-52-FI210-EP
3. Foliage Freeze Indicators: Description • Green vegetation appears windswept and "frozen." • Appearance depends on intensity and direction.	1B-53-FI210-EP
Foliage Freeze Fire Pattern Indicators: Fire Behavior • Green vegetation softens. • Vegetation bends with wind or gravity. • Heat removes moisture from the vegetation.	1B-54-FI210-EP

OUTLINE	AIDS & CUES
• Vegetation “freezes” into a fixed position.	
<u>General Reliability and Possible Exceptions – Foliage Freeze</u>	1B-55-FI210-EP
• Accurate wind direction indicator. • Possible exceptions: – Locations with a natural prevailing wind. – Pre-existing drought conditions in green hardwoods.	
<u>Advancing Fire Macroscale Fire Patterns – Foliage Freeze</u>	1B-56-FI210-EP
• Indication of wind direction. – Often points in direction of fire advance. – Contrast and compare to backing areas. – Reliable in advancing areas only.	
Note: Foliage freeze is reliable indicator of wind direction and may be used in combination with other indicators to support findings of fire spread direction.	

OUTLINE	AIDS & CUES
Backing Macroscale Patterns – Foliage Freeze • Much less windswept when compared to advancing areas. • Drooped appearance. • May still be somewhat brittle and dried out.	1B-57-FI210-EP
Backing Microscale Fire Pattern Indicators – Foliage Freeze • Generally not associated with backing fire. • May be observed when fire backs into strong wind in heavy fuels. • Compare/contrast. • Will be on correspondingly lower shrubs and may appear drooped rather than windswept.	1B-58-FI210-EP
4. Angle of Char Fire Pattern Indicators: Description: • The angle of the char compared to both the unburned portion of the object and the slope. • Angle differs with fire vector.	1B-59-FI210-EP

OUTLINE	AIDS & CUES
<u>Angle of Char Fire Pattern Indicators: Description – Scorch vs. Char</u> • Scorch and char are formed by the same process. • Difference between the two is a matter of heat duration and/or fire intensity. • Scorch typically appears on remaining crowns of trees or brush. • Char is the result of the burning away of portions of the actual crown. Note: Both can be used as an indicator.	1B-60-FI210-EP
<u>General Reliability and Possible Exceptions – Angle of Char</u> Generally reliable, especially for assessing advancing fire areas. Possible exceptions: • Flat surfaces/small diameters/short heights. • Fuel accumulations –uphill side when fire is backing downhill. • Old burns pre-existing char patterns. • Thin barked conifers/hardwoods –evenly blackened on all sides.	1B-61-FI210-EP 1B-62-FI210-EP 1B-63-FI210-EP

OUTLINE	AIDS & CUES
Advancing Fire Macroscale Patterns – Angle of Char	1B-64-FI210-EP
• Consistent pattern in advancing areas.	
• Steeper than the slope.	
• Low side – origin side.	
• Enters low, comes out high.	
• Clusters.	
• Contrast and compare to backing and lateral areas.	
• Due to the effects of wind, flame is drawn up the lee side of the pole-like object.	1B-65-FI210-EP
• Under high wind conditions this lee side char pattern can extend to great heights.	1B-66-FI210-EP
• The angle of the base char, however, will typically remain greater than the slope.	
Note: This same effect will be discussed in the section on backing.	
Note: Lower circle shows the angle of char that should be considered. The upper oval demonstrates the effects of the wind vortex and is an indicator of wind direction with the char caused by the vortex on the downwind side of the object. Make sure to emphasize that it is the bottom angle of char that the class/investigator should focus on.	

OUTLINE	AIDS & CUES
<u>Advancing Microscale Fire Pattern Indicators – Angle of Char</u> • Angle steeper than slope. • Small shrubs/seedlings. • Grass clumps. • Low end on exposed side.	1B-67-FI210-EP 1B-68-FI210-EP
<u>Backing Macroscale Fire Patterns – Angle of Char</u> • Parallel to slope on vertical fuels and foliage crowns. • Char may sometimes form an "L" or barber chair burn pattern. – Overall fire pattern remains parallel to the slope. – Fuel accumulation, catface, exposure to other nearby fuels or backing into high wind can create this char pattern.	1B-69-FI210-EP 1B-70-FI210-EP
Note: Catface means a partially healed old wound on the tree.	

OUTLINE	AIDS & CUES
Note: Looking at the first photo of the tree, the angle of char appears to be consistent with advancing fire. In the second photo, when more of a side view is taken, one can clearly see L-shaped char at the base of the tree. The high char extending up the lee side of the tree is the result of wind vortex wrap. Again, emphasize that it is the base of the char that needs to be examined. The foliage in the background clearly shows wind direction due to foliage freeze.	1B-71-FI210-EP
<u>Backing Microscale Fire Pattern Indicators – Angle of Char</u> • Will be parallel to slope, whether backing down-slope on a hill or against the wind on flat ground.	1B-72-FI210-EP
5. Spalling Fire Pattern Indicators Description: • Shallow craters or chips in the surface of rocks, with the exfoliated pieces laying on the ground. • Area surrounding crater is usually sooted/stained.	1B-73-FI210-EP

OUTLINE	AIDS & CUES
Spalling Fire Pattern Indicators: Fire Behavior • Also known as exfoliation. • Heat/flame exposure: – Rock not efficient conductor of heat energy. – Outer most layer becomes hotter than the rock underneath. – Differential expansion causes sub-surface shear stress. – Thin layers of rock break off, usually after the fire front has passed.	1B-74-FI210-EP 1B-75-FI210-EP
General Reliability and Possible Exceptions – Spalling • Usually reliable for advancing fire areas. • Not commonly encountered in backing areas. • Compare and contrast opposite sides of the rock. • Possible exceptions: – High fire intensity or long-term fire residency. – Mechanical damage. – Moisture in the rock or type of rock. – Pre-existing stress cracks.	1B-76-FI210-EP

OUTLINE	AIDS & CUES
<u>Advancing Macroscale Fire Pattern Indicators – Spalling</u> • On numerous large rocks within the run. • Concentrated on exposed side. • Absent/less evident on the protected side.	1B-77-FI210-EP
<u>Advancing Microscale Fire Pattern Indicators – Spalling</u> • On smaller rocks within advancing fire area. • Concentrated on exposed side. • Absent/less evident on the protected side.	1B-78-FI21-EP
<u>Backing Microscale Fire Pattern Indicators – Spalling</u> • Not usually associated with backing areas. • May be result of fuel accumulations. • Compare and contrast with spalling on the same type rocks in the advancing area. • Should be on the exposed side unless due to fuel accumulation.	1B-79-FI210-EP

OUTLINE	AIDS & CUES
6. Curling Fire Pattern Indicators: Description • Green leaves bend and curl inwards towards heat source. • Not normally a macroscale indicator. • May also exhibit wind influenced freezing.	1B-80-FI210-EP
<u>Curling Fire Pattern Indicators: Fire Behavior</u> • Similar to foliage freezing. • Heat exposure causes leaf to dry out and shrink on surface exposed to heat. • Shrinkage causes edges to curl in towards the source of heat.	1B-81-FI210-EP
<u>General Reliability and Possible Exceptions – Curling</u> Most reliable in low intensity/backing areas of the fire. Possible exceptions: • Degree of curing/long term drought. – Leaves may already be curled. • Direct flame impingement. – May impact leaves from a variety of different directions.	1B-82-FI210-EP

OUTLINE	AIDS & CUES
• Thick leaves with strong central vein. – May not curl at all or may curl in towards vein. • Wind driven foliage freeze. – Leaves may curl towards approaching heat source, but then move and freeze with the wind. Note: On thick leaves with strong central veins, the leave may curl in toward the vein regardless of which way the fire is approaching.	
Advancing Microscale Fire Pattern Indicators –Curling • Low intensity fire. • Not commonly associated with advancing fire. • Curling on the exposed side of vegetation.	1B-83-FI210-EP
Backing Microscale Fire Pattern Indicators –Curling • Small vegetation. • Leaves will curl towards the fire exposure. Note: This exhibits not only curling but also foliage freeze.	1B-84-FI210-EP

OUTLINE	AIDS & CUES
7. Sooting Fire Pattern Indicators	1B-85-FI210-EP
Description:	
• Black, carbon-based deposit.	
• Side exposed to flame/smoke.	
• Can be rubbed off.	1B-86-FI210-EP
<u>Sooting Fire Pattern Indicators: Fire Behavior</u>	1B-87-FI210-EP
• Airborne particulates resulting from the incomplete combustion of a carbon.	
• Complex mixture of organic compounds.	
• Adheres to: rocks, cans, fence wire, metal posts, some vegetation.	
<u>General Reliability and Possible Exceptions – Sooting</u>	1B-88-FI210-EP
• Generally reliable.	
Possible exception:	
• Accumulations of debris that generate large volumes of sooty smoke.	
<u>Advancing Macroscale Fire Pattern Indicators – Sooting</u>	1B-89-FI210-EP
• Look for noticeable soot deposits on large individual rocks and rock outcroppings or other similar objects.	

OUTLINE	AIDS & CUES
• Consistency within the run.	
<u>Advancing Microscale Fire Pattern Indicators – Sooting</u>	1B-90-FI210-EP
• Deposits on exposed side of object.	
<u>Backing Microscale Fire Pattern Indicators – Sooting</u>	1B-91-FI210-EP
• Not as heavy in the backing areas.	
• Exposed side of objects.	
• Relatively small objects in comparison to advancing areas.	
Note: Object in picture is a piece of bone. Jasper Fire.	
8. Staining Fire Pattern Indicators	1B-92-FI210-EP
Description:	
• Non-combustible objects.	
• Glossy, varnish-like stain, light yellow-orange to dark brown, on the exposed side.	
• May be tacky to touch.	
• White ash and light-weight fire debris may adhere to it.	

OUTLINE	AIDS & CUES
Staining Fire Pattern Indicators: Fire Behavior • Vaporized volatile oils/ resins - in the flame and smoke column. • Condensed onto cooler objects. • Residue greater on exposed side.	1B-93-FI210-EP
General Reliability and Possible Exceptions – Staining Generally reliable. Possible exceptions: • Repositioning of lightweight objects by wind or suppression activities. • Accumulation of man-made debris. Note: Objects that you may find staining on (e.g., cans) are more likely to be moved by suppression activities or wind. Repositioning can also be seen in other categories.	1B-94-FI210-EP
Advancing Microscale Fire Pattern Indicators – Staining • Exposed side of objects. • More pronounced in advancing than backing areas.	1B-95-FI210-EP

OUTLINE	AIDS & CUES
Backing Microscale Fire Pattern Indicators – Staining • Less noticeable in the backing areas, and may be very subtle. • Examine small pebbles, rocks and other similar items.	1B-96-FI210-EP
Sooting vs. Staining *Sooting*: • Dull black in color. • Can be rubbed off with fingers. • White ash will generally not adhere to it. *Staining*: • Glossy pale yellow to dark brown in color. • Cannot be rubbed off, but may be tacky to the touch. • White ash may adhere to it.	1B-97-FI210-EP
9. White Ash Exposure Description: • White ash on exposed side of trees, logs, limbs, or brush.	1B-98-FI210-EP

OUTLINE	AIDS & CUES
• Exposed side: – Lighter (white ash) – More damage • Protected side: – Darker – Texture difference – More color	
Note: Protected side: More color (meaning more unburned material, less damage).	
Note: Compare and contrast non-exposed side to exposed side.	1B-99-FI210-EP
<u>White Ash Exposure</u>: (cont.) • In grass stands, white ash may be more noticeable when looking away from the origin. • Looking back towards the origin, the grass may appear darker and/or may have more "color" due to protection on the non-exposed side.	1B-100-FI210-EP
If you were standing in the middle of this fire and looked in opposing directions, which way did the fire advance?	1B-101-FI210-EP

OUTLINE	AIDS & CUES
General Reliability and Possible Exceptions – White Ash Exposure • Thin-barked conifers/hardwoods may show more white ash on the protected side, particularly during strong winds. • Long term fire residency. Note: Long-term fire residency is an area in the fire where fuel accumulations or higher fuel moisture content cause the fire to burn for an extended period of time in place.	1B-102-FI210-EP
Advancing Fire Macroscale Patterns – White Ash • Compare and contrast opposing sides. • Look for consistency on similar objects.	1B-103-FI210-EP
Advancing Microscale Fire Pattern Indicators – White Ash Exposure • May be on relatively small objects. • May be closer to ground level.	1B-104-FI210-EP
Backing Macroscale Fire Patterns – White Ash Exposure • Less white ash overall, compared to advancing areas. • Darker appearance of burned materials.	1B-105-FI210-EP

OUTLINE	AIDS & CUES
• Appearance of "color" when compared to advancing areas. – Due to unburned fuels.	
<u>Backing Microscale Fire Pattern Indicators – White Ash Exposure</u> • Lack of or less white ash than the advancing areas. • Very fine fuels, and at levels that are generally closer to the ground on the exposed side.	1B-106-FI210-EP
<u>White Ash Deposit: Fire Behavior</u> • Dispersed downwind and layered on fuels and non-combustible objects. • Windblown white ash deposits.	1B-107-FI210-EP
<u>General Reliability and Possible Exceptions – White Ash Deposits</u> Possible exceptions: • Reliability/presence decreases with time. • Inconsistent dispersal under strong and variable wind conditions.	1B-108-FI210-EP

OUTLINE	AIDS & CUES
<u>Advancing Fire Macroscale Fire Patterns – White Ash Deposit</u> • Windblown transport – white ash deposits on similar objects over wide area.	1B-109-FI210-EP
<u>Advancing Fire Microscale Fire Patterns – White Ash Deposit</u> • White ash as a result of complete combustion of fuel.	1B-110-FI210-EP
<u>Backing Microscale Fire Pattern Indicators – White Ash Deposit</u> • White ash on the non-exposed side due to wind direction. Note: White ash deposits are created in backing areas, but transported downwind and deposited on the non-exposed side of objects.	1B-111-FI210-EP
10. Cupping Fire Pattern Indicators Description: • Concave or cup-shaped char. • Cup points to exposed side. • Advancing fire area. – Exposed side, blunted or rounded off.	1B-112-FI210-EP

OUTLINE	AIDS & CUES
– Charred branch tips on ground. – Non-exposed side pointed or cupped.	
<u>Cupping Fire Pattern Indicators: Fire Behavior</u> • Exposed side majority of damage. • Fuels of ½″ diameter or smaller most reliable. Note: Stump is vertical. Fire progressed from bottom to top. Larger diameters may be reliable but, need to be confirmed by additional indicator categories.	1B-113-FI210-EP
<u>Advancing Fire Microscale Fire Pattern Indicators – Cupping</u> • Ends of vegetation. • Low end of the cup: exposed side.	1B-114-FI210-EP
• Pointed on the protected side. • Blunted/rounded; exposed side on terminal twig ends.	1B-115-FI210-EP
<u>General Reliability and Possible Exceptions – Cupping</u> • Reliable in advancing areas.	1B-116-FI210-EP

OUTLINE	AIDS & CUES
• Possible exceptions: – Large diameter fuels – cup direction may be inconsistent with spread direction due to long term fire residency and possible change of wind direction. – Small diameter fuels – when wind is gusty and erratic.	
<u>Backing Microscale Fire Pattern Indicators – Cupping</u> • Usually not associated with backing areas. • When in backing areas – usually the result of high winds or long term fire residency.	1B-117-FI210-EP
11. V and U Fire Pattern Indicators Description: • Exterior perimeter V or U shape. • Cup of the U or apex of the V often contains the ignition area. • View/document from aerial perspective, if possible.	1B-118-FI210-EP

OUTLINE	AIDS & CUES
<u>V and U Fire Pattern Indicators: Fire Behavior</u> • U pattern – Light wind/flat ground – Origin on moderate slope • V pattern – High wind/flat ground – Origin on steep slope • Look below the canopy for pattern boundaries. Notes: The steeper the slope or stronger the wind the more likely you will get a "V" pattern. The flatter the slope or lighter the wind, the more likely you will see a "U" pattern. Different effects cause a "V' to broaden out to a "U". You see it predominately with light winds or on side hill origins that aren't really steep. Pattern boundaries may not be confined to fully consumed canopy. Look below the canopy to identify the actual fire boundary. On a smaller scale the pattern may not show up in the canopy, but may be visible below.	1B-119-FI210-EP

OUTLINE	AIDS & CUES
<u>V and U Fire Pattern Indicators: Fire Behavior</u> • "V" shapes are predominately influenced by wind and/or steep slope. • The stronger the wind, or the steeper the slope, the sharper the "V."	1B-120-FI210-EP
Consider: • Suppression methods/barriers. • Wind changes. • Slope changes.	1B-121-FI210-EP
Note: This again illustrates why it is important to establish fire behavior context. Understanding these elements will help the investigator to decipher these situations that would be much more difficult to figure out in the absence of the fire behavior context.	
<u>General Reliability and Possible Exceptions – V and U Fire Patterns</u> • Can be very reliable. Possible exceptions: • Rolling material • Wind shifts • Fuel type changes	1B-122-FI210-EP

OUTLINE	AIDS & CUES
• Spot fires • Suppression activities • Man-made or natural barriers	
<u>Advancing Fire Macroscale Pattern Indicators – V and U Fire Patterns</u> Consider: • Overall fire behavior context/environment. – Especially wind and slope interaction. • Fire suppression actions may affect overall shape.	1B-123-FI210-EP
Note: No "U" shape readily apparent because of the suppression activities below the road. If you are aware of the suppression activities below the road then the U shape is apparent.	1B-124-FI210-EP
Answer students' questions.	

UNIT OVERVIEW

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 1 – Fire Pattern Indicators

Lesson 1C – Fire Pattern Indicator Classroom Review

Time 1 Hour

Objectives

Review slides of fire pattern indicators in order to give students the opportunity to try their understanding of what has been taught in Units 1A and 1B.

Instructional Method(s)

- Informal lecture
- Classroom discussion
- Interactive group discussion

Instructional Aids

- ☐ Computer with projector, screen, and presentation software
- ☐ Sign-in sheet
- ☐ Flip charts and markers

UNIT PRESENTATION

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 1 – Fire Pattern Indicators

Lesson 1C – Fire Pattern Indicator Classroom Review

OUTLINE	AIDS & CUES
Present unit title slide.	1C-01-FI210-EP
Present "Review" slide and explain to students that this unit will present them with examples of fire pattern indicators in order for them to test themselves on what they have learned so far.	1C-02-FI210-EP
I. REVIEW Describe the following: • FIRE PATTERN INDICATOR CATEGORY: (protection, staining, angle of char, *etc*.) • FIRE VECTOR: (advancing, backing or lateral, if this can be determined from the slide) • DIRECTION OF FIRE SPREAD: relative to the slide (the fire spread from the top left to bottom right, top to bottom, *etc*.)	1C-03-FI210-EP
Note: Example in slide is angle of char (category), advancing (vector) from right to left in the photo (direction of spread). Explain to students that they should each independently come up with the category, vector, and direction of spread for each example to be shown.	1C-04-FI210-EP

OUTLINE	AIDS & CUES
Note: Example in slide is a combination of staining, protection, and white ash, advancing vector with fire spread towards the lower right corner	1C-05-FI210-EP
Note: Example in slide is protection shown by the tips of the leaves being still intact on the left side of the plant while they are burnt off more on the right side of the plant, advancing vector from lower right to upper left	1C-06-FI210-EP
Note: Example in slide is foliage freeze as demonstrated by the direction the leaves are fixed at, advancing vector with fire spread from right to left in photo. Remind students that this is primarily a wind direction indicator and should be validated with other nearby indicators.	1C-07-FI210-EP
Note: White ash on left side of grass and absent on right side is one indicator of fire direction, also present is an angle of char indicator where the left side of the grass is burned down lower than the right side creating the angle on the bunch of grass. Protection by the grass itself created less damage to the right side of the bunch than to the left indicating the fire direction of spread. Advancing vector from left to right in the photo.	1C-08-FI210-EP
Note: Cupping of the tree stump shows an advancing vector with fire spread from lower left to upper right. Remind the students that we generally say that cupping is more reliable on materials that are ½" or smaller. However, it can also be reliable on larger fuels when confirmed with other indicators.	1C-09-FI210-EP

OUTLINE	AIDS & CUES
Note: Foliage freeze with a lower degree of damage to the foliage itself indicates a backing fire vector with the wind moving from left to right consistent with the leaf freeze and the fire backing from right to left into the wind on flat ground.	1C-10-FI210-EP
Note: After moving the bottle that provided the protection to the fuels below it, a more raged and less burned edge can be seen on the left side as compared and contrasted to the cleaner burn on the right edge of where the bottle had laid. This is an example of a microscale indicator that must be observed close-up due to its subtle nature. Fire is advancing from right to left in the photo.	1C-11-FI210-EP
Note: In this example, protection by the fuel itself, the branch or stem, has caused the fire to almost extinguish on the far side. A lateral vector is present based on the lower intensity of the fire at this location. Students should be warned that this same effect can take place due to suppression activities, providing a misleading vector. Clues indicating suppression activities should be looked for. Fire is progressing from lower left to upper right.	1C-12-FI210-EP
Note: Protection on the limb is indicated by heavy char to the right end of the limb while the left end is less damaged and is protected by the other end of the limb. Vector is advancing due to the degree of damage, fire progressing from lower right to upper left.	1C-13-FI210-EP

OUTLINE	AIDS & CUES
Note: Protection is indicated by the char on the side facing with no char visible on the back side of the objects. This is a good example of where students should take an additional photograph to more clearly document the back side of this fire pattern indicator. Vector is advancing from lower left to upper right.	1C-14-FI210-EP
Note: In this aerial view a macroscale "V" pattern can be observed with all three vectors represented at different locations in the photo. Remind students that the ignition area is often located up wind or downslope of the apex of the "V" pattern, in the less burned area. Note how there are more green canopies in the apex area of the "V", indicating a lower intensity fire consistent with an ignition area nearby. Fire is progressing from right to left in photo.	1C-15-FI210-EP
Note: Protection on turtle shell indicated by char on the lower left edge while no char is present on the upper right edge, indicating a fire moving from lower left to upper right. Two additional protection indicators are present making up a cluster of fire pattern indicators. Backing vector determined due to lower consumption of fine fuels.	1C-16-FI210-EP
Note: This photo taken in Australia shows an angle of char on the trunk of the tree with higher consumption of fuels consistent with an advancing fire vector. Fire is progressing from left to right. Remind students to be careful not to interpret wind vortex flame wrap char pattern on tree as an indicator of anything other than wind direction.	1C-17-FI210-EP

OUTLINE	AIDS & CUES
Note: The cones in this photograph show char on the near side and protection on the far side. This is another example where a second photograph would help to clearly document this indicator. Unburned pine needle behind the cones due to protection from the cones adds a cluster of protection indicators. This is an advancing indicator which may be difficult for the students to determine without further data. Remind them of the combined use of the fire behavior context and the fire pattern indicator to determine the vector. Fire is progressing from bottom to top. Remind the students that objects such as pine cones can move and they should be checked for signs of having done so.	1C-18-FI210-EP
Note: Small amount of char on the upper left side of the plant leaves indicates a fire moving from upper left to lower right. The low degree of damage on the leaves indicates a lower intensity fire consistent with a backing vector. The lack of char to the lower right side of the plant leaves indicates protection was provided by the leaves themselves.	1C-19-FI210-EP
Note: An angle of char on the tree trunks which is parallel to the ground indicates a backing vector from lower right to upper left in photo.	1C-20-FI210-EP
Note: Protection, advancing from lower left to upper right.	1C-21-FI210-EP
Note: Angle of char category shown on crown of trees with angle indicating fire progression from left to right in photo and the height of the char indicating an advancing vector.	1C-22-FI210-EP

OUTLINE	AIDS & CUES
Note: Grass stem fire pattern indicator category with lower consumption of stems consistent with either a backing or lateral vector, depending on the comparison and fire behavior context. Fire spread is from left to right in the photo.	1C-23-FI210-EP
Note: Green leaves curling (category) inwards towards the heat source with lower leaf consumption consistent with a lower intensity fire and a backing vector. Fire is progressing from foreground to background based on direction of leaf curl.	1C-24-FI210-EP
Note: The side of the tree trunk exposed to the higher intensity flaming front results in more combustion of the bark and creation of white ash (category) remains on the side exposed when compared to the side protected from the flaming front. Higher consumption of fuels is consistent with an advancing vector progressing from bottom to top in the photo.	1C-25-FI210-EP
Note: Angle of char (category) is seen on the trunk of the tree which is level with the ground indicating a backing fire from upper left to lower right. A secondary indicator in the form of protection (category) is seen on the palm branches which shows less consumption of the leaves on the right side than the left. (Photo taken in New Zealand)	1C-26-FI210-EP
Note: Photos show both protection of the grass stems on the back side of the rock and staining on the exposed side of the rock providing a cluster of indicators consistent with an advancing vector from lower right to upper left. Remind students of importance of photographing the rock in place before it is moved.	1C-27-FI210-EP

OUTLINE	AIDS & CUES
Note: Fiberglass road marker. Heat causes fiberglass on exposed side to expand out. Notice angle of char on sign as well.	1C-28-FI210-EP
Note: Photo shows area of protected needles after the group of pine cones has been moved. Protection category with advancing vector from lower left to upper right.	1C-29-FI210-EP
Note: Be cautious when using grass stem indicators in green grass.	1C-30-FI210-EP
Note: Angle of char (category) present on the lower portion of this tree trunk with an angle steeper than the slope consistent with an advancing vector from left to right in photo. Remind students of wind vortex flame wrap present on this trunk (above arrow) which indicates the direction of the wind and is not part of the angle of char fire pattern indicator.	1C-31-FI210-EP
Note: Angle of char (category) indicator pattern on the trunk of these trees form part of a cluster of supporting indicators with the angle being parallel to the ground, consistent with a backing vector from left to right.	1C-32-FI210-EP
Note: A cluster of indicators exists in this photo on and around the rock shown, with staining on the rock, more white ash in the fuels on the exposed side of the rock than on the protected side of the rock, and unburned protected fine fuels on the protected side of the rock indicating a moderate intensity lateral vector progressing from the upper right to the lower left in photo.	1C-33-FI210-EP

OUTLINE	AIDS & CUES
Note: Sooting on rocks and grass stems (categories) indicate a moderate intensity fire consistent with a lateral vector progressing from lower left to upper right.	1C-34-FI210-EP
Note: Angle of char (category) is present on this tree canopy with needle freeze (category) indicating wind direction consistent with angle of char and an advancing vector in the direction of the wind from right to left.	1C-35-FI210-EP
Note: Angle of char (category) present in the form of scorch rather than actual char on the needles of these trees. Scorch gets higher on the canopies as the fire gains intensity indicating an advancing vector from lower left to upper right in photo. Angle of scorch – sub category of angle of char.	1C-36-FI210-EP
Note: Spalling an sooting (categories) present on rock are compared and contrasted to the opposite side of the rock to determine the advancing vector of this fire from lower right to upper left in photo. Remind students that they are at a disadvantage when relying on one photo, showing the need for good documentation and multiple photos when comparing and contrasting.	1C-37-FI210-EP
Note: This downed sampling stem shows one side charred while the other is protected (category). It is unknown if this is an advancing or lateral fire due to a lack of data. Remind students that this can happen to them when they fail to fully document a fire pattern indicator. Fire is moving from upper right to lower left.	1C-38-FI210-EP

OUTLINE	AIDS & CUES
Note: Sooting and staining (categories) present on facing side of rock with absence of them on back side of rock indicating fire moving from lower left to upper right in photo. Consumption of fine fuels on the ground indicates an advancing vector.	1C-39-FI210-EP
Note: This was on the very edge of the lateral transition zone. In background, the grass stems are falling in toward the run at a 45° angle. Angle of char on the tree trunk greater than the slope indicates an advancing vector from right to left or lower right to upper left. Foliage freezing on leaves confirms a wind direction consistent with the advancing vector.	1C-40-FI210-EP
Note: Protection (category) indicator on the cone shows char on near side and no char on back side, consistent with fire moving from lower left to upper right. Low consumption of leaves and needles indicates a backing vector. Remind students of need to make sure cone has not rolled since being burned by looking underneath it and documenting that area.	1C-41-FI210-EP

OUTLINE	AIDS & CUES
Review Objectives	1C-42-FI210-EP
1. Describe the effects of fire on combustible and non-combustible objects.	
2. Describe and classify the various fire pattern indicator categories.	
3. Correctly assess vectors within the various fire pattern indicator categories.	
4. Explain the underlying fire science principles that govern the formation of the indicators.	
5. Apply a systematic method and use the fire pattern various indicators to trace fire progression back to the ignition area.	
6. Describe the general appearance of the fire pattern indicator.	1C-43-FI210-EP
7. Explain the fire behavior behind its formation.	
8. List general reliability/possible exceptions.	
9. Describe characteristics for each vector category.	
Answer students' questions.	

UNIT OVERVIEW

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 2 – Methodology

Time 2 Hours

Objectives

1. Describe methodology.
2. Define terms used in origin and cause methodology.
3. Identify the processes in origin and cause methodology.
4. Describe methods used to identify and process an “Ignition Area.”

Instructional Method(s)

- Informal lecture
- Classroom discussion

Instructional Aids

☐ Computer with projector, screen, and presentation software
☐ Sign-in sheet
☐ Flip charts and markers

UNIT PRESENTATION

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 2 – Methodology

OUTLINE	AIDS & CUES
Present unit title slide. Present unit objectives.	02-01-FI210-EP 02-02-FI210-EP

I. UNIT OBJECTIVES

1. Describe methodology.

2. Define terms used in origin and cause methodology.

3. Identify the processes in origin and cause methodology.

4. Describe methods used to identify and process an "Ignition Area."

Note: In the following slides discussing the "Scientific Method" and "Methods," there will be several slides reinforcing the same point. This is done in an effort to present this subject matter to the student, who often is new to it, in a way that will best reinforce the learning and understanding of it.

Advise the students that some of the following material will be new to them and requires their complete attention. The materials they cover in this unit will definitely be seen by them again during testimony.

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The instructor may want to mention at some point that the "Scientific Method" of problem solving is a concept taught in many states at the 4th and 5th grade level and is actually the basis for the way many of us solve problems. We just don't put it into a format as specific as what is formally presented.	
II. METHODOLOGY	02-03-FI210-EP
<u>Stages of the Investigation</u>	
• Actions taken prior to the fire.	
• Receiving the assignment.	
– Obtain weather data.	
– Check for aerial photos from detection/suppression aircraft.	
• Actions taken en route to the fire.	
Note: The use of a systematic approach or methodology takes place during all stages of an investigation.	
• Actions taken upon arrival.	02-04-FI210-EP
• Determining the origin.	
• Identifying the cause (ignition source and ignition factors).	
• Documenting the investigation.	

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A methodology is the systematic application of a problem solving framework and the methods, procedures, and techniques common to the field of wildland fire investigation as applied to solve the problems of the specific scene conditions and needs. It is the combination of a: **Framework** (for problem solving) and **Methods.** Note: In this class, Methodology is being taught as the systematic application of methods, procedures, and techniques common to the field of wildland fire investigation as applied to solve the problems of the specific scene conditions and needs. The methodology taught is comprised of a framework for systematic problem solving, and the specific methods, procedures, and techniques applied to each individual fire scene based on that framework. The key thought to convey to the students in this slide is that "Methodology" is the combination of a systematic framework (In this case the suggested framework is the Scientific Method) and the selected "methods" from the field of wildland fire investigation applied by the investigator(s) for each specific scene. The "Methods" being used systematically within the Scientific Method framework of solving a problem.	02-05-FI210-EP

OUTLINE	AIDS & CUES
Note: Definition of "Methodology" 1: a body of methods, rules, and postulates employed by a discipline: a particular procedure or set of procedures. 2: the analysis of the principles or procedures of inquiry in a particular field (Merriam-Webster)	
• Methodology: Key Words – Systematic : Orderly, thoroughness, methodical, regularity – Methods: Practices, procedures, techniques	02-06-FI210-EP
Note: Methodology: The orderly (systematic), thorough, methodical, and regular application of practices, procedures and techniques. This slide is meant to reinforce the thought stated in the previous slide, that of Methodology being the combination of a systematic process and applicable methods.	
Systematic: • Methodical in procedure or plan, a systematic approach, marked by thoroughness and regularity, systematic efforts (Merriam-Webster).	02-07-FI210-EP

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Note: The student should be made aware that conducting a systematic investigation is not something that just happens; it should be a planned process which is used regularly in an effort to add consistency and reliability to each investigation. By doing so, the chances of succeeding are increased. A systematic process is different than the methods used to accomplish a systematic investigation. The systematic process being the framework for applying the methods to accomplish the specific investigation.	
<u>Methods:</u> • Recommended procedures, practices, and techniques. • Typically specific to a discipline. • Peer reviewed. • Generally accepted by profession. • Applied to a specific scene. • Resulting in the generation of data.	02-08-FI210-EP
Note: There are numerous methods which can be applied to accomplish a systematic investigation. These methods are often unique to the specific discipline. The scientific method is an outline which in and of itself does not provide or specify the specific methods that should be applied to solving each problem. It is up to the investigator(s) to make the decision as to which methods best apply to the specific problem.	

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Note: Selected methods should be those which are recommended and accepted by the discipline and profession of wildland fire investigation. Methods which have not been generally taught or reviewed by the wildland fire investigation community are not excluded from use but should be explained in the documentation of each case report and reasons listed for the application of such methods.	
Applying a Systematic Method(s):	
<u>Facilitates investigative competency.</u>	02-09-FI210-EP
• Helps avoid premature conclusions.	
• Helps avoid bias.	
• Helps avoid use of rumor, conjecture, speculation.	
<u>Facilitates consistent approach.</u>	
• Investigation methods.	
• Complete documentation.	
• Applicable testing.	
Note: A systematic application of methods which have been peer reviewed and accepted by the profession of wildland fire investigators will reduce the number of challenges on purely procedural grounds and add the weight of the community to each investigation. Consistent application of methods used during wildland fire investigations leads to good habits and practiced skills.	

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Systematic Process: There is more than one systematic process, and numerous procedures, practices, and techniques (methods). Together, they form a "Methodology." • In this unit we will discuss the general systematic process called the "Scientific Method." • And recommended procedures, practices, and techniques associated with wildland fire investigation (investigative methods). Note: The "Scientific Method" is the bones or framework, and the methods are what puts meat on the bones. The two must come together to form a "systematic method." While the "Scientific Method" forms a framework which is generally applied across disciplines, the methods applied within the framework are specific to the discipline and are modified as needed to apply to specific conditions of each fire scene.	02-10-FI210-EP
II. SCIENTIFIC METHOD Note: This slide is meant to be an introduction to the six components of the "Scientific Method". They will be described in detail in later slides. **The instructor should avoid the use of the term "steps"** which may confuse the students into thinking they must be conducted one step at a time. This will be explained in the following slides.	02-11-FI210-EP

OUTLINE	AIDS & CUES
Scientific Method (Process): • "principles and procedures for the systematic pursuit of knowledge involving the recognition and formulation of a problem, the collection of data through observation and experiment, and the formulation and testing of hypotheses" (Merriam-Webster) • While the process stays the same for each discipline, the techniques (methods) are specific to the discipline and scene conditions. Note: "…a method or procedure that has characterized natural science since the 17th century, consisting in systematic observation, measurement, and experiment, and the formulation, testing, and modification of hypotheses" (Oxford Dictionary) Use slide to reinforce the thought that it is the marriage of the scientific method "techniques" or processes with the specific methods used in the discipline of wildland fire investigation that make up a "Methodology." As with every scientific experiment, where different methods are applied to various specific experiments, due to each individual aspect, the application of the specific method to a given specific fire scene and problem dictates the ability to apply those methods which best fit the specific situation.	02-12-FI210-EP

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Note Continued: "Natural sciences: are those branches of science that seek to elucidate the rules that govern the natural world through scientific methods, the cornerstone of which are measured by quantitative data. Based on formal sciences, they also attempt to provide mathematical models of natural processes." (Wikipedia) "Definition: any of the sciences (as physics, chemistry, or biology) that deal with matter, energy, and their interrelations and transformations or with objectively measurable phenomena." (Merriam - Webster) The "Scientific Method" was not designed specifically for the investigation of wildland fires or for that matter for the investigation of any crime or violation. Therefore it may not be a perfect fit for these types of investigations but forms a good framework of thought to which appropriate methods must be applied. The scientific method (process) does not exclude the use of methods regularly used during law enforcement investigations of all types.	
<u>Example:</u> • Scientific Method – collect data. • Plan – Follow burn pattern to origin. • Method – Start at the most burned and work back to the least burned. (May include multiple methods to establish origin).	02-13-FI210-EP

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Example: The specific method of working from the most burned to the least burned is the opposite as the method prescribed in structure fire investigation, where it is typically the reverse.	
Note: The "Scientific Method" provides the outline of "collect data", the investigator needs to form a plan to conduct data collection which will include methods for the collection of specific data such as the fire pattern indicators which show fire spread direction and lead back to an origin. Notice that the "method" selected is specific to the discipline of wildland fire investigation and is contrary to that used in structure fire investigation. This is a basic example of why the "Scientific Method" does not include discipline specific methods to be applied. It is also a good example of why peer reviewed and accepted methods (start at the most burned and work back to the least burned) should be applied.	
• Recognize the need, define the problem (Need/Problem) • Define the problem (Investigative Plan) • Collect data (Facts) • Analyze the data (apply meaning) • Form working hypotheses (based only on data) • Test the hypotheses/select the final hypothesis **Six parts, not necessarily sequential steps.**	02-14-FI210-EP

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Note: The "Scientific Method" is made up of six parts which are not always taking place in the sequence listed and may overlap other processes. Again, avoid using the term "steps", which may give the student the impression that it is a step by step process.	
Note: The processes inside the circle are frequently occurring simultaneously and are ongoing throughout the investigation. Need = Conduct fire investigation to determine causation – mitigate future problems. Problem = specific fire event. Data – Fire Scene, Interviews, Research, Testing, etc.	02-15-FI210-EP
<u>Example of scientific method:</u> • I need to get to work (Need). Car will not start (Problem). • I need to check the gas, battery, ignition, etc. (Plan and Data collection) • I analyze the data and find I have no gas, the battery is charged, and the ignition is working. (Analyze the data) • Based on analysis of the data, I form a hypothesis that my car will not start because I am out of gas. (Develop a hypothesis) • Put gas into the car and it starts up (Testing and final hypothesis).	02-16-FI210-EP

OUTLINE	AIDS & CUES
The outline, which is the Scientific Method is applied to each part of the investigative process: *Example*: • Applied to evaluate each indicator. • Applied to determination of origin. • Applied to determination of cause. • Continuous process. Note: A wildland fire investigation is really made up of a number of processes or parts, each process or part can be accomplished individually or in concert with other parts by applying the scientific method to each. This often results in different parts of the scientific method being applied to different processes at, or nearly at the same time.	02-17-FI210-EP
<u>Recognize</u> Need, <u>Define</u> Problem: • *Example*: Agency policy requires that an origin and cause investigation be done on each wildland fire which takes place within its jurisdiction. (Need) • A wildland fire has ignited in the agency's jurisdiction and the origin and cause must be determined. (Problem) Note: The needs may be numerous and/or more general, such as; The agency needs to prevent future fires and to do so it must investigate each origin and cause to provide data for a fire prevention plan of action.	02-18-FI210-EP

OUTLINE	AIDS & CUES
Note: The problem may be defined more specifically, such as; A wildland fire was ignited ten days ago and the area of origin is only now available for examination and investigation of the origin and cause.	
Define the Problem:	02-19-FI210-EP
• Applying the scientific method (process), clearly recognizing the **need and problem,** and specifically defining the **problem,** leads to the formation of an **investigative plan** which will assist in solving the problem and increase the potential of success.	
• An investigative plan will focus on methods which generate **empirical data** (facts).	
Note: An investigative plan may be provided in writing or communicated verbally. During extended investigations, written plans are encouraged. It is important that each member of the investigative team understand what the plan is and what their roll is in carrying out the plan. To coordinate and update the plan on an extended investigation, one person should review all new data, convey the needed information into modifications of the plan, and make the investigators aware of new pertinent data and how it relates to the plan and the investigation as a whole.	
Investigative Plan:	02-20-FI210-EP
• Define the problem. (Need to determine cause and responsibility).	

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- Establish the objectives. (Interview witnesses, establish fire behavior context, locate origin, determine ignition source(s), determine ignition sequence, etc.).
- List the tasks (read fire pattern indicators, etc.)
- List the assignments (Investigator Smith, etc.)
- Timeline (By Wednesday noon)
- Adjust the plan according to new data.

Note: A plan does not exist unless it includes what the problem is, what is the objective(s), the tasks for reaching the objective are identified, someone is specifically made responsible for accomplishing a task or tasks, and a due date is established.

The plan is only good until new data is collected which indicates a need to change the plan. Sometimes this is simply done by crossing off a task when it is completed and other times it includes modifying the plan to reflect new investigative leads (tasks) that need to be assigned to someone and a due date established.

Any modification of the plan should trigger a discussion among the investigative team as to the significance of that change to the overall investigation.

The investigative plan is all about data collection leading to a better understanding of what has occurred. This will drive tasks.

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Note: Example: Who saw the fire early on? John Smith witnessed the start of the fire. Smith will be interviewed on Monday by Investigator Robert Jones. Jones will provide a written summary and recording of the interview to the lead investigator for review.	
• As empirical data continues to be collected, the plan is modified to reflect the new information gained and new data collection needs.	02-21-FI210-EP
Note: Reinforce the need for the lead investigator to review all the data, modify the plan accordingly, and the need to keep the investigative team briefed on all the pertinent data as it is developed. The key here is to give the investigative team members the knowledge they need to be able to identify what the issues are and how data/information relates to the overall investigation. The lead investigator will review the data received from investigator Jones and modify the plan to reflect new questions, sources of data, the process for specific data collection, and brief the team on the data known to date.	
<u>Collect Data – Empirical Data:</u> 1**:** originating in or based on observation or experience <*empirical* data> 2**:** relying on experience or observation alone often without due regard for system and theory <an *empirical* basis for the theory>	02-22-FI210-EP

OUTLINE	AIDS & CUES
3**:** capable of being verified or disproved by observation or experiment <*empirical* laws> (Merriam-Webster) Verifiable, true, factual, relevant. Note: In the investigative world, "Empirical Data" is simply "Facts" based on observation and experience that justifies a belief in the truth or falsity of an empirical claim. Students may be more comfortable with using the terms fact, or factual, in their reports and discussions and this is fine. The students should understand however that the term "Empirical Data" may be presented to them during examination and they need to be able to explain their understanding of it. "It is a capital mistake to theorize before one has data. Insensibly, one begins to twist facts to suit theories, instead of theories to suit facts." **Sherlock Holmes to Watson** *A Scandal in Bohemia* Note: While the character Sherlock Holmes made this statement to his sidekick Watson, Holmes was often found theorizing with very little data. The key is that as Holmes theorized, he formed "working hypothesis", not "final hypothesis", and then he proceeded to accumulate further data which confirmed or rejected his hypotheses, or was used to form new hypotheses. There is nothing wrong with forming working hypotheses using limited data, as long as the investigator understands that there may be a number of working hypothesis which will require additional data to sort out.	02-23-FI210-EP

OUTLINE	AIDS & CUES
"A working hypothesis is a provisionally accepted hypothesis proposed for further research." (Wikipedia) It should be understood that while more data may be good for sorting out hypotheses, that does not mean that all possible data must be accumulated prior to selecting a final hypothesis. In fact, it is probably the rare occasion when all possible data is collected prior to coming to a conclusion. There is no minimum standard amount of data which must be collected before a "working hypothesis" can be formed. Arriving at the scene of a small fire located underneath a set of power lines may be enough data to form a working hypothesis of electrical lines as a cause of the fire. Further data collection may result in the hypothesis being selected as the final hypothesis, dropped as a possible hypothesis, or even retained as a possible hypothesis. The investigator should be cautioned against applying general data to a specific situation early on to form a hypothesis. An example would be, I know that there are power lines in the area where the fire was reported and therefore I can form a working hypothesis that power lines are the cause of the fire. It would be better if specific information, i.e., I arrive at the scene and find power lines in the general origin area, is used to form a hypothesis.	

OUTLINE	AIDS & CUES
Collect Data – Empirical Data:	02-24-FI210-EP
• Specific sources of empirical data include: – Observations – Witness statements – Physical evidence – Experiments – Experience – Other data collection processes	
Note: This is not an all-inclusive list of data sources. Witness statements are considered to be empirical to the witness themselves, but are indirect to the investigator until it can be verified and known to be true upon which time it becomes empirical data. Example: Witness states that he observed that at mile post 49, the road turned to the right. A check of a map or actual observation by the investigator that the road does turn right at mile post 49 makes it empirical data. It has been verified and known to be true.	
• *Example*: A rock is found which is observed to have more staining on the west side than on the east side. This observation is empirical data when it can be verified and known to be true.	02-25-FI210-EP
The difference between data and empirical data.	

OUTLINE	AIDS & CUES
• Data collection starts upon the dispatch.	02-26-FI210-EP
• Data collection and analysis often take place at nearly the same time and at all stages of the investigation:	
Example 1: Analysis of each fire pattern indicator for reliability typically takes place at the time that the indicator is identified.	
Example 2: Analysis of witness statements for accuracy and truthfulness may take place at the same time as the data is collected.	
<u>Analysis of the Data:</u>	02-27-FI210-EP
Part 1. Analysis for reliability: Takes place during the collection of the data to assure that it is factual and verifiable= empirical data.	
• Must take place before data is used in forming a working hypothesis.	
• Only empirical data, that which is based on observation or experience, which is verifiable or true is used to form working hypotheses. (Data collection may continue)	
Note: The two parts of data analysis are similar to the test which many judges use to determine the use of expert testimony. Is it factual, and is it pertinent (what does it mean to the case)? Just as the judge is the "gate keeper" of information to a jury, the investigator is the "gate keeper" of factual information used to form working hypotheses.	

OUTLINE	AIDS & CUES
Note: Only data that can reasonably be determined to be factual should be included in the formation of working hypothesis. This first part is determining if data/information is really data/fact. The second part, covered in the next slide, is to determine what the data/fact means.	
Analyze the Data: Part 2. Analyze all the empirical data to determine its meaning (explain the problem) and form the basis for working hypotheses. • Based on the knowledge, training, experience and expertise of the individual doing the analysis. • Assists in forming working hypotheses by avoiding speculation and conjecture. • Assistance in the analysis may be requested from someone more qualified. • Data collection often continues during this process.	02-28-FI210-EP
Note: Is the data pertinent to the case? If so, what does it mean to the case? While an investigator may be able to answer this question based on their knowledge, training, experience, and expertise, sometimes they may not be qualified or only minimally qualified to answer this question. In that case, requesting assistance from a more qualified person in that specific area of inquiry may be the appropriate level of analysis.	

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In many instances, an initial analysis may be made by the investigator(s) which is later subject to further analysis by someone more specifically qualified.	
Example – Data: • SOA is established to be 10' by 10.' • Power line is on the ground at the SOA. • Witness observed electrical arcing. • Fulgurite was found in ignition area.	02-29-FI210-EP
Note: "A thought experiment or Gedanken experiment (from German) considers some hypothesis, theory, or principle for the purpose of thinking through its consequences. Given the structure of the experiment, it may or may not be possible to actually perform it, and, in the case that it is possible for it to be performed, there need be no intention of any kind to actually perform the experiment in question. The common goal of a thought experiment is to explore the potential consequences of the principle in question." (Wikipedia) "Thought experiments" are mental concepts or hypotheses, similar to riddles, which are used by scientists as simple ways of testing a hypothesis, often used where physical experiments aren't possible or cannot replicate the specific conditions of the problem. As in the slide example, while an investigator or scientist, based on experience, training, education, etc., can conduct a thought experiment about how an energized power line coming into contact with the general fuels in the origin area of a wildland fire may have started the fire, they often	

OUTLINE	AIDS & CUES
cannot recreate the specific weather, fuels, and topography that were actually present at the scene at the time of ignition for a laboratory experiment. This aspect of fire investigation is well recognized, that is, that during a fire, the actual components, arraignments, and conditions of the elements of the scene are destroyed or modified to the extent that it cannot be accurately to a detail recreated. However, thought experiments can be applied to the general conditions and like conditions experienced on other fires by the investigator. In such cases, scientific testing in a laboratory will not assure actual recreation of the specific conditions of the fire scene at the time of ignition and may not be as reliable as thought experiments based on experience, training, and expertise in the area.	
<u>Analyze: (thought experiment)</u> Experience, training, and expertise indicate that energized power lines are a competent ignition source. Empirical data indicates that a working hypothesis of a downed power line as an ignition source should be considered<u>.</u>	02-30-FI210-EP
<u>Ongoing Data Collection:</u> • The process of empirical data analysis continues as new data is received, validated, and compared to existing working hypotheses. • The ongoing analysis of new data may result in the reinforcing or modification of existing working hypotheses, falsification and exclusion of existing working hypotheses and/or the creation of new working hypotheses.	02-31-FI210-EP

OUTLINE	AIDS & CUES
Application of Data: • Empirical data collected is used to form working hypotheses using inductive reasoning. • Empirical data is later used to test each working hypotheses in an effort to falsify them using deductive reasoning. Note: The formation of working hypotheses is done using the process of inductive reasoning. The testing of working hypotheses to come to a final hypothesis is done using the process of deductive reasoning.	02-32-FI210-EP
Inductive Reasoning: • Inductive reasoning is based on experience or empirical data alone, often without regard for system or theory. – It is capable of being verified/falsified by observation (further empirical data) or experiment. • The whole body of evidence (empirical data) is reviewed and considered • Objectively analyze the data and form working hypotheses for the fire Note: While this slide repeats information first presented in slide 23, it serves to tie the information to "inductive reasoning" and reinforces this point which can be difficult for investigators to understand.	02-33-FI210-EP

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Inductive Reasoning: (cont.)	02-34-FI210-EP
Example: • I have investigated fifteen fires that were caused by a discarded cigarette. • I recovered a discarded cigarette in the ignition area of all fifteen fires. • I recovered a discarded cigarette within the ignition area of this fire. • Therefore, the cigarette caused the fire. (Hypothesis)	
You now have a working hypothesis that must be tested by deductive reasoning.	
Working Hypotheses:	02-35-FI210-EP
• A hypothesis is a proposed explanation for a phenomenon: – What were the weather conditions at the origin? – What the fire patterns indicate? – Where the ignition area is located? – What was the ignition sequence? – What may have caused the fire? – Who was responsible for igniting the fire? • Based on empirical data analysis.	

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Note: As listed, there are a number of questions being asked and which need to be answered. By forming a working hypothesis for each of the questions the entirety of the hypotheses can be put together to form a working hypothesis which answers all the questions. In some cases, individual hypothesis may be discarded or modified in the on-going process of developing a working hypothesis that accounts for all the data/facts.	
<u>At this point, can we form our final hypothesis as to the cause of the fire? No.</u>	02-36-FI210-EP
Note: However, a working hypothesis may be formed during the ongoing collection of data. Observing a burn barrel smoking in the heel of the fire is data collection and can lead to the formation of a working hypothesis. Again, the investigator should be cautioned to remember that the formation of a single working hypothesis does not relieve them from additional data collection and development of alternative working hypotheses as the data dictates. On the other hand, when no additional empirical data/facts, indicate reasonable alternative hypotheses, a single working hypothesis may be all that the data supports. Either way, the process of data collection and possible working hypothesis development must be allowed to proceed to come to that point.	

OUTLINE	AIDS & CUES
Hypothesis:	02-37-FI210-EP
• Hypothesis: "…an interpretation of a practical situation or condition taken as the ground for action." (Merriam-Webster)	
• "a tentative assumption made in order to draw out and test its logical or empirical consequences." (Merriam-Webster)	
Working Hypotheses:	02-38-FI210-EP
• Developed only when data has been collected and analyzed.	
• Based on the empirical data.	
• Not based on speculation, rumor, or conjecture.	
• Empirical data may support only one hypothesis, or support development of multiple hypotheses.	
• May start with one hypothesis and add others as additional empirical data is collected, analyzed, and supports other reasonably possible hypotheses.	
• Hypothesis may be discarded if new data falsifies it.	
Note: During the formation of possible hypotheses, those hypothesis which are considered should be referred to as "working hypotheses." Only after testing of all reasonably possible working hypotheses can a determination of a final hypothesis be made.	

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Working Hypotheses:	02-39-FI210-EP
No potential ignition source found. • There are times when no ignition source will be found, yet witness statements and/or other information indicates an ignition sequence indicative of an incendiary or accidental cause.	
Note: Key thought here is that when there is no evidence of a potential ignition source found, a working hypothesis of open flame device, incendiary, or an accidental cause can be formed if it is consistent with all other data and an ignition area has clearly been identified and defined. There is no minimum size that the ignition area must be gotten down to for this determination. However, the entire ignition area should have been thoroughly and systematically searched and no evidence of a possible ignition source found prior to making a determination to include a working hypothesis of incendiary or other accidental cause.	
No potential ignition source found. (cont.)	02-40-FI210-EP
• The investigator may form a hypothesis and come to an opinion of cause based on this information as long as it is consistent with all other data and a well-defined ignition area. • Additional factors may be used to establish a working hypothesis when the origin area is clearly defined. (Not based on speculation, conjecture, or rumor).	

OUTLINE	AIDS & CUES
Incendiary Factors: • Lack of accidental ignition sources. • History of incendiary fires in area. • Geospatial clustering of incendiary fires. • Temporal clustering of incendiary fires. • Multiple fires not related to accidental cause. • Modified fuel bed. • Ignitable liquids present not associated with other uses.	02-41-FI210-EP

Note: The investigator is cautioned not to rely upon a single factor in this list to form a working hypothesis of incendiary unless the factor is significantly unusual and it clearly cannot be explained by mere coincidence.

The history of incendiary fires in the area should be recent, such as within the last few years. While two fires in a nearby area maybe an indication of a developing problem, they may have to be classified as "undetermined" in cause until additional data can be gathered with which a working hypothesis of incendiary can be formed.

The locations (geospatial) of the historical incendiary fires should be such that when compared to the fire under investigation, the physical location is near other known incendiary fires, and in locations which are similar in nature to the other known incendiary fires, thus creating a "cluster" of like fires.

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Note: The time of day, day of the week, months, etc. create a common pattern which cannot be easily explained by coincidence. This may include the absence of fires during certain times of the day, days of the week, etc. Multiple fires not related to an accidental cause does not include two ignition areas near each other which can be attributed to evidence of a common accidental cause. Example, four (multiple) fires along a roadside at the same general time may be determined to be incendiary in nature except when evidence of catalytic converter parts is found at the origin of three of them. Modified fuel bed means the fuels in the ignition area have been arraigned to facilitate the ignition and/or spread of the fire.	
<u>Incendiary Factors</u>: (cont.) • Remote location with view blocked. • Roadside area with low detection risk. • Access blocked (gate, cut tree, etc.) • Normally blocked access is open (unlocked gates). • Fire suppression equipment committed or disabled. • Witness statements. These factors are not all-inclusive; the investigator may consider other similar factors but should not rely on just one or two factors to determine a cause.	02-42-FI210-EP

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Note: Remote area relates to the ease with which the scene is accessed and the level of protection from detection that the remote site allows.

Roadside areas with low detection risk includes nighttime fire starts when traffic is low and headlights can be seen from a distance or can be portions of highways which allow someone to pull over to the side of the road and see long distances down the roadway for other traffic. This may also include areas where bends in the road at each end allow a person to eject an incendiary device without being seen by other traffic on the road.

Access blocked includes anything that may hamper fire suppression resources during their response. This may be created by the responsible party or simply taken advantage of by the responsible party.

Open areas that are not normally open indicate forced entry.

Fires occurring consistently during periods of fire suppression commitments to other incidents or when local fire equipment may have been tampered with to make it useless for fighting the fire.

Witness(es) observe a person or vehicle of similar description leaving the area at a high rate of speed on multiple occasions. The investigator should be cautioned against relying upon a single incident of a person or vehicle leaving the area as there are often witnesses who have nothing to do with starting the fire who leave the area without being identified.

OUTLINE	AIDS & CUES
Incendiary Factors – Examples: • Four fires in last three months on Mondays and Tuesdays between 2:00 AM and 4:00 AM with no ignition source found within a four mile stretch of dirt road. • Three fires located behind locked gates or where a tree had fallen and blocked the road. Each fire was ignited in the middle of the night with a low risk of detection. The fuels in the ignition area were all piled pine needles. No ignition source was found Note: Again, the key here is the reliance on multiple factors common over multiple days of fires. Accidental Factors – Examples: • Origin area clearly defined and searched. • No reasonable accidental ignition source is found after a thorough search of origin. • No reliable factors of incendiary cause. • Witness statements support a specific cause. • Video tape or photographic evidence supports a specific accidental cause. • Data supports specific cause.	02-43-FI210-EP 02-44-FI210-EP

OUTLINE	AIDS & CUES
Note: The basis of all determination of cause is the establishment first of a specific origin area or ignition area. There are some exceptions where a credible case can be made about the cause of a fire without determining the specific origin area. In that case, many of the factors listed here may be used to establish a circumstantial case for the fire cause. In most cases, the clear determination of a specific origin area and the search of that area in a systematic way will lend further data which can provide stronger evidence of a cause. Absent direct evidence, the investigator may use the one or more of the factors listed to provide an opinion that the fire was of a specific accidental cause.	
<u>Accidental Cause – Examples</u>: (cont.)	02-45-FI210-EP
• *Example*: No ignition source evidence was recovered from a 5' by 5' specific origin area after a thorough search. Witness statements indicate that metal tracked equipment was working in the area just prior to the fire being reported.	
• A rock was found in the origin with evidence of rock to metal track contact and/or,	
• Video from a nearby camera shows smoke coming from the area shortly after the equipment passed the point where the fire started.	
<u>Test the Hypothesis:</u>	02-46-FI210-EP
• Testing is conducted by comparing all the data (facts) and/or applicable scientific research in an effort to see if any of the hypotheses can be falsified.	

OUTLINE	AIDS & CUES
• Valid hypotheses are those which can withstand serious tests when compared to all the known facts (empirical data) and scientific knowledge associated with the <u>specific</u> phenomena. (Deductive reasoning)	
Note: The purpose of testing a hypothesis is to see if it can be falsified by the data. If a particular hypothesis has been falsified by the data, prior to rejecting it, the data used to falsify it should once again be analyzed to see if the data itself is truly factual and reliable. If the data is found not to be reliable or factual, it should be replaced by data that is and the process of testing the hypotheses conducted over.	
<u>Deductive Reasoning:</u>	02-47-FI210-EP
• Reasoning from a hypothesis to account for specific empirical data, research or experimental results. – Must be supported by the facts. – Testing may be either cognitive or experimental. o Many fire causes will be tested cognitively, *i.e.*, based on knowledge, research and experience. o Others will lend themselves to further experimental testing.	
• Key analysis to this process is: "what other hypothesis could be supported by the same set of facts?"	02-48-FI210-EP

OUTLINE	AIDS & CUES
– If there are alternative hypotheses that are supported by the same facts, then the investigator may not have gathered sufficient data. – Gather more data and re-test.	
Note: Deductive Reasoning: “Deductive reasoning, also deductive logic or logical deduction or, informally, "top-down" logic,[1] is the process of reasoning from one or more general statements (premises) to reach a logically certain conclusion. [2] Deductive reasoning links premises with conclusions. If all premises are true, the terms are clear, and the rules of deductive logic are followed, then the conclusion reached is necessarily true. Deductive reasoning (top-down logic) contrasts with inductive reasoning (bottom-up logic) in the following way: In deductive reasoning, a conclusion is reached from general statements, but in inductive reasoning the conclusion is reached from specific examples.” (Wikipedia)	
<u>Deductive Reasoning</u>: (cont.) • Deductive reasoning begins with a general premise, (based on inductive reasoning), which leads to a specific conclusion. • The reasoning starts with a hypothesis, (Premise 1), moves to an observation, (Premise 2), and finishes with the findings. (Conclusion)	02-49-FI210-EP

OUTLINE	AIDS & CUES
Example: • *Premise 1* – If a cigarette is discarded into finely-particulated fuels under certain environmental conditions, it is more likely than not to start a fire. • *Premise 2* – A cigarette was recovered within the specific origin area of the fire and the fuel bed and environmental conditions were consistent with known conditions, based on research and experience, that are conducive to a cigarette caused ignitions. – The cigarette was consistent in appearance with a recently discarded cigarette. – The fire direction indicators led back to within a few inches of the cigarette. – No other alternative hypothesis supports these facts. • *Conclusion* – Therefore, it is more likely than not that the cigarette caused the fire	02-50-FI210-EP
<u>Deductive Reasoning: Analysis process</u> Typical analysis questions that should be considered: • Does the hypothesis make sense in the context of all the facts? • What facts support/contradict the hypothesis? • Is there research that supports/contradicts the hypothesis?	02-51-FI210-EP

OUTLINE	AIDS & CUES
• Can a peer review falsify/support the hypothesis?	
• What interpretation may an opposing expert apply to falsify the hypothesis?	02-52-FI210-EP
• What are the factual weaknesses of the hypothesis?	
• Is there an alternative way to interpret the data?	
• If so, why is your interpretation the correct one?	
<u>Scientific Knowledge: Caution</u>	02-53-FI210-EP
• It is recognized that it is impossible to replicate the exact conditions present at the location of a specific fire at the time of ignition.	
• Published scientific testing and experiments often address similar but not precise conditions as those present at the specific fire scene.	
Note: The less that is known about the actual conditions at the scene at the time of ignition, the harder it is to recreate those conditions. Therefore, the investigator should strive to collect all useful data at the scene that is practicable in an effort to reconstruct the scene for testing purposes. Example: If there are pine needles, dry grass, duff, punky wood, and bark present at the origin of the fire, it should be recognized that each specific fuel can have a different ignition probability. The propensity for a pine needle to ignite is not the same as that of dry grass, or duff, or punky wood.	

OUTLINE	AIDS & CUES
Knowledge and experience pertaining to wildland fuels and their ignition characteristics is one way to test these fuels in thought experiments. Ignition tests may be conducted specifically on each of these components as it is often impossible to say just which of these fuels was the first fuel ignited.	
<u>Test the Hypothesis:</u> • Testing can be completed by conducting "thought experiments" which apply known scientific principles to the hypothesis. • Testing by "thought experiments" maybe augmented by various degrees of physical testing, at the same time or at a later date.	02-54-FI210-EP
Note: Thought experiments are often used due to the fact that the exact conditions of the specific fire scene cannot be exactly reconstructed. Thought experiments use related experience combined with relevant research to form conclusions in a general fashion. When an investigator does not have the specific experience, knowledge, or education to conduct a reasonably reliable thought experiment, additional experts may be needed to provide such experience, knowledge, and education.	
<u>Example:</u> • You find remains of a cigarette near the ignition area. • You develop a working hypothesis that the fire was started by a cigarette.	02-55-FI210-EP

OUTLINE	AIDS & CUES
• How do you test the hypothesis? – Fire patterns do/don't lead back to the cigarette remains. – Weather information does/does not support the range conducive to cigarette ignition. – Examination of the cigarette remains reveals that it was/was not in place before the fire.	
Note: Albert Einstein used conceptual (thought experiments) rather than actual experiments in creating the theory of relativity.	
<u>Test the Hypothesis:</u> • Physical testing can (and often will) be conducted by the investigator and/or others more qualified. • For physical testing to be valid, it should closely represent the conditions and circumstances actually present and test all components of the item.	02-56-FI210-EP
Note: Physical testing may cast doubt but fall short of falsifying. In such a case it is up to the investigator to determine if the doubt is significant enough to change his/her level of confidence in their opinions. Testing which casts doubt upon a hypothesis should also be evaluated for reliability, factual basis, and specific applicability. Further testing may be indicated but may not exclude a preliminary opinion based on sufficient other data.	

OUTLINE	AIDS & CUES
Physical testing should include all components of the item being studied. For example, if a fuel bed is made up of pine needles, duff, punky wood, dry annual grass, etc., testing the ignitability of one component i.e., pine needles, does not establish the ignitability of the entire fuel bed and any opinion by the investigator and or an expert which broadly applies such testing results to all the fuel components is misleading at best.	
<u>Test the Hypothesis: (cont.)</u> Re-analysis of the data or analysis of new data collected may be applied to this process. • If no hypothesis withstands the testing process, the cause should be "undetermined" at that time. • The development of additional data or analysis may provide for the determination of cause on a fire previously classified as undetermined.	02-57-FI210-EP
Note: Investigator has asked the lineman to determine how much travel the middle conductor, which has come off its insulator, has in an effort to test the hypothesis that the middle conductor was blown into the conductor on the left side causing an arc. The lineman pulled the conductor back to the outside conductor showing how much movement it could have and then let go of the middle conductor to allow it to swing freely on its own which resulted in the middle conductor swinging over to and past the left outside conductor.	

OUTLINE	AIDS & CUES
Note: The lineman falls in the category of other qualified expert who may know more about the subject than the investigator.	
<u>Select Final Hypothesis:</u> • If only one hypothesis withstands testing, that hypothesis typically becomes the final hypothesis. • When two or more hypotheses withstand testing, the investigator must determine if the facts support one hypothesis to be probable, over others that are just reasonably possible.	02-58-FI210-EP
Note: The final hypothesis is the one and only hypothesis which is not falsified by the data to the level of probable. There may remain hypotheses which are reasonably possible and not falsified but which the data does not support to the level of "probable." This determination is the sole responsibility of the investigator who must be able to support such a decision with the known data.	
<u>Level of Certainty:</u> The investigator is being asked for their opinion. Investigator's opinion is based on their confidence in the data, data analysis, and testing of the hypothesis. • How strong do you hold your opinion? • Two levels of certainty commonly used: – Probable – Possible	02-59-FI210-EP

OUTLINE	AIDS & CUES
Note: Probable: "…supported by evidence strong enough to establish presumption but not proof" (Merriam-Webster) Possible: "a : being within the limits of ability, capacity, or realization <a possible but difficult task> b : being what may be conceived, be done, or occur according to nature, custom, or manners <the best possible care> <the worst possible circumstance> (Merriam-Webster) All things may be considered possible, but in the context of wildland fire investigation, "reasonably possible" is what is being considered.	
<u>Probable:</u> • The investigator should know how certain they are of their expert opinions. • Likelihood hypothesis is true is greater than 50%. • If only one hypothesis is determined to be "probable," then an opinion can be expressed. • Even when there are other possibilities.	02-60-FI210-EP
Note: When no hypothesis rises to the level of probable, then no hypothesis can be likely true greater than 50%.	
• The investigator should clearly document the data which is used to form their opinion as to the "probable" cause of a fire.	02-61-FI210-EP

OUTLINE	AIDS & CUES
• The investigator should be prepared to give testimony pertaining to the data upon which they relied for their opinion to determine probable cause of a fire.	02-62-FI210-EP
Possible:	
• Hypothesis is feasible but not to the level of probable.	
• If two or more hypotheses are equally likely, then the level of certainty must be "possible" for both.	
– Undetermined	
• Only when the level of certainty is considered "probable" should an opinion be expressed with reasonable certainty.	
Note: If an investigator is having trouble determining which of two hypotheses that are supported by the data is the correct one, it is a good indication that neither rises to the level of probable and thus the cause may need to be "undetermined" without further data to support one over the other.	
Premature Assumptions: Expectation Bias	02-63-FI210-EP
• Coming to a final conclusion without considering all relevant data (facts).	
• Data developed by an investigator indicating certain activities or events does not indicate expectation bias.	

OUTLINE	AIDS & CUES

For example: A witness provides a statement indicating a certain potential cause of the fire early in the investigation. This does not constitute expectation bias unless the investigator ignores factual data that could indicate other potential causes.

Note: Investigators should avoid any type of bias in their investigation. The way to do that is to follow the pertinent leads no matter where they take the investigation while employing a systematic methodology. This allows the investigator to come to a final conclusion after all pertinent information has been considered.

An example of possible bias would be if an investigator was provided with information, not found to be rumor, speculation, or conjecture, which indicated a possible cause of the fire and that factual information was ignored during the investigation. Discounting of information found to be only rumor, speculation, or conjecture is not bias.

This same failure to follow a lead could simply be due to poor investigative practices having nothing to do with bias at all, highlighting the problems with determining bias in the mind of another.

It is common for investigators to arrive at the scene of a fire and be told by witnesses about a possible cause of the fire. Such statements in and of themselves do not make the investigator biased. To determine what impact such information has on the thinking of an investigator, it would be necessary in most cases to climb inside the investigators mind.

OUTLINE	AIDS & CUES
If the statement from a witness about a cause results in the investigator ignoring evidence of other reasonably possible causes and a total focus only on the cause given by the witness, which may lead to questions during testimony about the potential for bias in the investigation. There will be times when the evidence only supports a single cause. This may be totally based upon a reliable witness statement who saw the actual fire ignite and the responsible person present at the time. It may also take place only after many leads were followed and found to only support one hypothesis. Either way, good documentation goes a long way in showing the totality of what was considered and why. Research which seems to confirm bias during an investigation is almost always done using controls to determine the potential for bias. Such research does not rely on the opinion of quasi experts who testify to their opinions about bias in the minds of others based solely on reading an investigative report or other non-research sources.	
<u>Premature Assumptions: Confirmation Bias</u> • Using the data to prove a hypothesis rather than test it and attempt to disprove it. • Test all hypotheses for which there is supporting data. Follow all the investigative leads that the factual data identify. **“A man should look for what is, and not for what he thinks should be.”** **- Albert Einstein**	02-64-FI210-EP

OUTLINE	AIDS & CUES
Note: During the hypotheses testing process, the data should be applied in an effort to disprove or falsify each reasonable hypothesis. The investigator does not need to pursue unsupported theories just to prove that confirmation bias does not exist. Hypotheses are formed based on the empirical data/facts and not rumor, speculation, or conjecture. Once the facts have been established, they are then compared to each hypothesis to see if they are incompatible with that hypothesis.	
III. METHODS	02-65-FI210-EP
Note: The second part of a "Methodology" (after the scientific method framework) are the discipline and scene specific "methods" applied by the investigator. The following methods that will be discussed are not all inclusive of methods that can be used. These methods are simply recommended based on peer review and many years of use. Each scene will dictate the use of specific methods as each scene is unique. These methods should be practiced on a regular basis in order to develop a systematic method familiar to the investigator. The final responsibility for determining the best application of methods to a specific scene lies with the investigator. The investigator therefore will be held responsible during testimony in explaining why certain methods were used and how they were used.	

OUTLINE	AIDS & CUES
1. <u>Arrival at the Fire Scene:</u> • Investigation Plan (Continuous Process) • Faced with multiple priority tasks • Each fire different • Difficult for single investigator – Identify safety issues – Secure origin – Obtain on-scene weather – Identify witnesses – Locate and secure evidence	02-66-FI210-EP

Note: The investigation begins at the time of dispatch. Certain investigative practices take place during the receipt of the dispatch and during the response to the fire which will be discussed in combination with documentation of such activities in Unit 5, Documentation.

Upon the arrival at the fire scene, many issues will be competing for the attention and time of the investigator. Sizing up the needs and situation should lead to a plan of attack. The investigative plan will often be verbal in nature initially and may expand to a written document during extended investigations.

OUTLINE	AIDS & CUES
Actions on Arrival at Fire:	02-67-FI210-EP
Preliminary area of protection • Based on fire behavior context and witness statements • Determine the Investigative priority • Evaluate first responder protection area • Use barrier tape or flagging as appropriate	

Note: The spot in the middle of the flagged area shows where suppression crews disturbed the origin during hose stream application. While this is not an uncommon event in either wildland or structure fire investigations, it does not mean that an ignition area and cause cannot be determined.

In addition to using the fire behavior context and witness statements to determine the preliminary area of protection, the investigator will use observations of macroscale indicators and physical evidence to determine the area or areas to be protected.

There are a number of suggested methods for marking and protecting the fire scene. These may include the use of simple flagging, more specific barrier tape, roadblocks, guards, etc. It is the responsibility of the investigator to select the method or methods which best serve the needs of the specific scene. The investigator may need to remove barrier markings during witness interviews at the scene in an effort to reduce the influence such markers may have on the witness. In addition, the level of protection may change due to additional exposures to traffic or lack of exposure to traffic in the area.

OUTLINE	AIDS & CUES
Actions on Arrival at Fire: (cont.) • Suppression Witnesses – First responders, lookouts, aerial observers o Size on arrival o Specific fire behavior o Fire progression o Suppression strategy o Weather o Evidence o Witnesses • Civilian Witnesses – Identification – Preliminary statement – Re-contact information	02-68-FI210-EP

OUTLINE	AIDS & CUES
Note: Reinforce the "Scientific Method", see below. The way a person interviews a witness is the "method", while the act of gathering the data, analyzing it for reliability, and testing it against other reliable data is the "Scientific Method". Interviewing witnesses is a key component to establishing the initial area of protection and general origin area. Witness statements should be analyzed for reliability and tested against the fire behavior context, fire pattern indicators, and other witness statements before using as part of the empirical data/factual information to form a working hypothesis.	
<u>Actions on Arrival at Fire</u>: (cont.) • Physical Evidence – Locate – Protect – Secure • Environmental Conditions – Assess conditions: too hot or smoky, falling snags (beetle kill areas), rolling material, darkness, hazardous materials, other hazards – Secure and delay entry until scene is safe/acceptable.	02-69-FI210-EP

OUTLINE	AIDS & CUES
Note: Physical evidence can be almost anywhere. A reasonable search of the area in and around the heel of the fire and access routes or other areas of potential activity may produce physical evidence which will need to be protected and secured. This may include areas removed from the fire origin. Safety is the first priority. Conditions at a scene may prevent the immediate search for the origin of the fire. If this is the case, secure the general area as best as possible. Other tasks such as taking weather, interviewing witnesses, etc. should continue in a timely fashion.	
<u>Actions on Arrival at Fire: (cont.)</u> • Tasks – Interviews – Scene security – Scene examination – Evidence collection – Scene documentation • Additional Resources – Other investigators – Forensic specialists – Experts ***The tasks drive the resource need.***	02-70-FI210-EP

OUTLINE	AIDS & CUES
Note: Based on the number of tasks that need to be completed and the time and effort required to accomplish them, the investigator should form a plan of investigation which identifies needs for additional resources such as investigators, law enforcement, other experts, etc. Resource requests should be made in a timely fashion considering the time lag for response of such resources.	
<u>Evidence Protection Area:</u> A reasonable expectation of where evidence may be found based on experience, observation, location and specifics of that incident. • Both outside and inside the burn. – Look up, down, and all around. • Be cognizant of where you put your feet and where resources drive and park. • Minimize the impact.	02-71-FI210-EP
Note: Evidence protection can start outside of the black, even miles away. When walking around, look before you plant your feet inside and outside the black. Walk where you walked before when possible to minimize impact.	

OUTLINE	AIDS & CUES
2. Areas of a Fire Scene:	02-72-FI210-EP
Note: The fire area is broken up into several specific areas, including: Overall Fire Area, General Origin Area (GOA), Specific Origin Area (SOA), and the Ignition Area (IA). These terms and areas will be discussed in the following slides. The investigator should start to put out fire pattern indicator flags at the time that they will be useful in documenting the data or to assist in understanding the fire pattern as the investigator works. It is up to each investigator to determine when they need the flags out.	
Determining Origin and Cause:	02-73-FI210-EP
• General Origin Area – Macroscale indicators – Fire behavior context – Witness statements – Generally one-half acre or less	
• Specific Origin Area – Fire progression first influenced by wind, slope or fuels. – Generally no smaller than 5'x 5'. o May be smaller o Dependent upon indicator o Indicators become more subtle	

OUTLINE	AIDS & CUES
– Transition zone between advancing and backing indicators	
Note: The size of the General Origin Area is going to be dictated by what the indicators determine, not the potential ignition sources. Once the General Origin Area has been identified by use of macroscale indicators, witness statements, and the fire behavior context, a boundary may be determined. The specific origin area is where the investigator is primarily looking at microscale indicators and generally needs to be down on their hands and knees or stooping to observe the indicators and potential evidence.	
<u>Determining Origin and Cause:</u>	Slide 2-74-FI210-EP
• Ignition Area	
– The smallest location which a fire investigator can define, within the specific origin area, in which a heat source and fuel interacted with each other and a fire began.	
– Physical remains of ignition source may be present or in close proximity.	
– Validate with fire pattern indicators. **No matter how obvious.**	

OUTLINE	AIDS & CUES
Note: Students may be familiar with the term "Point of Origin" and want to ask questions about it. In almost all wildland fires, an exact point where the first fuels ignited and come into contact with a heat source, "Point of Origin," cannot be determined. This is due to the fact that from the time that a fire originates, is ignited, to the time an investigator arrives at the specific origin area, decomposition of the fuels and other physical makeup of the scene has been destroyed or altered, particularly on the microscale. Thus it is far more realistic to speak in terms of the smallest area able to be defined based on the fire pattern indicators and fire behavior context.	
3. <u>Determining the Origin and Cause:</u> • Point of Origin: The exact physical location <u>within the</u> ignition <u>area</u> where a heat source and the fuel interact, resulting in a fire. • Rarely located on a wildland fire • Not necessary to identify the "exact point" in order to determine a cause.	02-75-FI210-EP
Note: The point of origin is a term which denotes an "exact physical location". Once a wildland fire ignites, the fuels and heat source immediately begin to be destroyed and/or move during the combustion process. Because of this, it is rare and often unrealistic to expect that an "exact physical location", "point of origin", can be identified.	

OUTLINE	AIDS & CUES
Note: Any determination of an "ignition area" or "point of origin" should be based upon the reliable fire pattern indicators present. Those indicators often become fewer and less reliable as the exact physical location is approached where the heat source and fuel came in contact, often leading to an area of no reliable fire pattern indicators. The practice of identifying an "ignition area" allows the investigator to clearly define the perimeter of the smallest area that can be determined relying on fire pattern indicators. Attempting to further refine the area down to a "point of origin" beyond what can be determined by using fire pattern indicators leads to speculation and/or reliance on evidence of a heat source rather than the fire pattern indicators. It is not necessary to find the "point of origin", the "exact physical location", in order to determine a cause. It is necessary that an ignition area be identified and that a systematic examination of that area be completed in order to identify all possible evidence of a heat source(s) or cause of the fire. For these reasons, the "ignition area" concept is far more realistic than the application of a "point of origin" and is the recommended area and term used during an investigation of a fire's origin.	
<u>Determining Origin and Cause:</u> Determining the General Origin Area • Examine burned area. – Recommend working from the advancing area. o Exceptions	02-76-FI210-EP

OUTLINE	AIDS & CUES

- Establish fire behavior context
- Macroscale patterns
- Witness Statements
- Examine unburned area
  - Reconstruction of probable fuel conditions in burn
  - Other evidence
- Photograph as needed and consider aerial photography.

Note: When working to identify the General Origin Area, it is recommended that the investigator(s) first identify an advancing area of the fire consistent with witness statements and the fire behavior context. This is often identified by high intensity burning and higher consumption of fuels. Evaluating damage differential between areas of high fuel consumption and those of lower or low fuel consumption will assist in the identification of advancing, lateral, and backing fire spread.

Exceptions: fires that do not include advancing indicators. For example, a fire burning from a roadway into a wind may only demonstrate lateral and backing indicators; fires starting on a ridge top or peak may only demonstrate backing indicators; fires on flat ground and no wind; fires burning during periods of high humidity and/or fuel moisture with no wind or slop influence. The recommended method for these situations is to follow the most demonstrative indicators back to where they come together.

OUTLINE	AIDS & CUES
One method for working this initial area of advancing fire back to the ignition area is to observe macroscale indicators within and along the flanks of the advancing area. This can be done by working a zig-zag pattern between the transition areas on the flanks or where visibility makes it possible to view macroscale burn indicators from a distance, other patterns may be employed. When examining the unburned area, any effort to link the fuel conditions of such an area to the ignition area should be specific to the ignition area itself. This may mean a second look at representative unburned fuel beds after the ignition area has been identified. This should lead to finding a representative unburned fuel bed which reflects the ignition area in brush or tree stocking, brush or tree species (that actually contribute to the ground fuels where the initial ignition took place), ground fuel species and stocking, and disturbances to the fuel bed (configuration) and continuity. Documenting this representative fuel characteristics will assist in future testing and testimony.	
<u>Determining Origin and Cause:</u> Examining the General Origin Area • When transition zones, control lines, or other information indicates that it is safe to do so, walk the perimeter twice, once in each direction. • Mark general origin area. • Enter from advancing area when possible.	02-77-FI210-EP

OUTLINE	AIDS & CUES
• Work across run until lateral transition zone is reached (flank). • Move towards origin and re-cross burn until opposing lateral area is reached. Note: If other resources are there and available (dog, man tracker) these other resources should be consulted about the plan of action and needs. <u>Determining Origin and Cause:</u> Examining the General Origin Area • Identify fire pattern indicators with visible markers. • Recommended method: – Red flag for advancing. – Yellow flag for lateral. – Blue flag for backing. – White flag for evidence only. – Lime green flags for areas, items, or points of interest.	02-78-FI210-EP

OUTLINE	AIDS & CUES
Note: White flags should only be used to mark evidence and may be used in the ignition area when evidence is present. Use lime green flags for areas, items, or points of interest (e.g., the four corners of the ignition area or visual representation of the reference points, etc.). Explain the lime green flags in the report.	
<u>Determining Origin and Cause:</u> Examine the General Origin Area • Macroscale/microscale fire pattern indicators. • Continue until specific origin area is reached. • Mark evidence as you go.	02-79-FI210-EP
Note: This example shows the use of the perpendicular lane technique.	02-80-FI210-EP
<u>Determining Origin and Cause:</u> Identify the Specific Origin Area • Mark specific origin area. • Walk perimeter at least twice. • Examine/photograph area prior to entering. – Indicators – Visible potential ignition sources – Other evidence	02-81-FI210-EP

OUTLINE	AIDS & CUES
Note: Consider using binoculars to examine indicators and visible potential ignition sources prior to entering the SOA.	
Determining Origin and Cause:	02-82-FI210-EP
Specific Origin Area	
• The manner in which you conduct the search of your specific origin area will be dependent upon the conditions that exist on scene	
• There are a number of suitable techniques available to conduct a search of a specific origin area	
• Whatever method is chosen, should reflect a systematic approach that protects scene integrity as much as practical	
• We will discuss tools that may or may not be applicable to your specific scene	
4. Specific Origin Search Techniques:	02-83-FI210-EP
Perpendicular Lanes	
• Lanes perpendicular to run.	
• Work from advancing end of SOA.	
• Stakes and strings	
– Suggest using bright color.	
• Lanes 12”-18” width.	
• Search each lane and then move closest string forward.	

OUTLINE	AIDS & CUES
Note: Closest string is the one closest to the investigator (farthest from the suspected ignition area).	
Specific Origin Search Techniques:	02-84-FI210-EP
Parallel Lane • Lanes are laid out parallel to advancing fire progression, towards suspected ignition area. • Work lanes towards suspected ignition area. • Ensure that far lane ends are established in the green or well into the backing area. – Do not disturb the specific origin area when laying out lanes. • Works well with multiple investigators or narrow SOA.	
Specific Origin Search Techniques:	02-85-FI210-EP
Grid • Squares/rectangles – Size is dependent upon scene circumstances. • Useful when the locations of multiple pieces of evidence need to be documented or when you plan on collecting the debris for sifting/examination. • Grids should be numbered/lettered for documentation.	

OUTLINE	AIDS & CUES
Note: Search process when using the grid will be dependent on the scene. This technique can be used when there is a large amount of evidence at the scene to be collected.	
<u>Determining Origin and Cause:</u> Examine the Specific Origin Area • Search lane visually. – Consider using magnification and/or straight edge to focus vision.	02-86-FI210-EP
Note: There is a variety of conditions that may exist at the Specific Origin Area depending on the fire intensity, fuels present before and after the fire, and other possible variables. In fact, variations within the fuel bed at the Specific Origin Area may necessitate the use of magnification in some parts of the visual scan and not in others. Magnification may include a standard magnifying glass, magnifying glasses, or other such devices. The use of a straight edge or other such techniques for keeping track of the area visually searched and in some instances to assist in focusing on an area helps to conduct a systematic visual search.	

OUTLINE	AIDS & CUES
Determining Origin and Cause:	02-87-FI210-EP
Magnet to search for ferrous metal. • Pull-release best • Sweep surface • Check often	
Metal detector to search for non-ferrous metal.	
Determining Origin and Cause: • Continue to read and mark indicators and evidence in each lane or grid. • Remove top debris layers to expose indicators and/or ignition source. – Brushing – Blowing	02-88-FI210-EP
Determining Origin and Cause: • Sift debris with nested screens if necessary. – 1/4 and 1/8 inch screen • Move to next lane and repeat. • Bag debris for future analysis when appropriate.	02-89-FI210-EP

OUTLINE	AIDS & CUES
Note: If a determination is made that the debris will be bagged, the grid technique for conducting a search allows for more precise locating of where each bag of debris came from. Each grid can be marked and the debris in most cases from each grid put into a single bag. When bagging of the debris is to take place, it is still recommended that the debris be searched prior to collection. This may allow the investigators to locate items which may be destroyed during the bagging of the debris. In some cases it may be best to collect the debris grid by grid as the search is completed for that individual grid. In other instances it may be better to wait and collect the debris after all the grids have been searched. It is up to the investigator to select the sequence of processing the scene which best fits the scene and provides the needed evidence protection.	
<u>Determining Origin and Cause:</u> • Continue until ignition area is reached and/or evidence of ignition source is located • Secure and document evidence • Continue past evidence or ignition area until clear backing indicators are noted • Document/ photograph	02-90-FI210-EP
Note: Circled item in photograph is piece of catalytic converter.	

OUTLINE	AIDS & CUES
Ignition Area:	02-91-FI210-EP
• Continue to work search pattern up to and through the ignition area.	
• Identify and document the boundaries of the ignition area.	
– Reference points	
– Measurements	
– Photos	
Determining Origin and Cause:	02-92-FI210-EP
• Secondary Origin and Cause Determination	
• Second opinion	
– Major case	
– No physical evidence of cause	
• Origin should be kept secured and as undisturbed as possible.	
– Scene integrity	
– Contamination issues	
– May be several hours/days	
Determining Origin and Cause:	02-93-FI210-EP
Addressing potential ignition sources found in specific origin area.	

OUTLINE	AIDS & CUES
• Data indicating ignition sources. – Physical evidence – Witness statements – Personal observations – Fire history – Other data specific to the incident	

Note: This process is meant to replace the old method of inclusion/exclusion and is meant to clarify the manner in which potential ignition sources are considered.

Everything is possible. Investigators need to address what is reasonable based on the data obtained.
The investigator needs to address in their documentation all physical evidence of potential ignition sources found in association with the specific origin area. For example, a lighter that is found on the trail leading to the specific origin area.

For example: The investigator finds a piece of metal and a cigarette butt in the specific origin area. They will need to address both of those potential ignition sources.
The investigator is provided information from an eye-witness that a person was seen fleeing the scene or fireworks were heard and seen in the area. Both of these possible ignition sources would need to be addressed.

OUTLINE	AIDS & CUES
Summary:	02-94-FI210-EP
• Collect and analyze data.	
• Base all hypotheses on empirical data. (Facts)	
• Test all hypotheses against the empirical data.	
• Reject those hypotheses which are falsified by the empirical data.	
• Select a final hypothesis if it alone fits all the empirical data. (Probable v. Possible)	
• Base your opinions on the empirical data.	
Note: Base all hypotheses on empirical data (Facts), using "Inductive Reasoning" Test all hypotheses against the empirical data, using cognitive or actual experiments and applying "deductive reasoning."	
• The "Scientific Method" (framework) plus the specific methods used equals "methodology."	02-95-FI210-EP
• A systematic method of fire investigation assists the investigators in doing a thorough and complete job.	
• Avoid bias, back opinions with data, and apply representative tests to the hypothesis.	
• Apply accepted methods to the specific scene.	

OUTLINE	AIDS & CUES
Note: The Scientific Method is only a framework for problem solving and must have the specific methods used within the wildland fire investigation discipline to make up a "Methodology". Systematic Method = Locate an advancing run; use witness statements, fire behavior context, and macroscale indicators to work back to the general origin area; work between the lateral transition zones to follow macroscale and microscale indicators back to the specific origin area; conduct a systematic search of the specific origin area using microscale indicators to lead to the ignition area; search the ignition area and beyond for evidence of an ignition source.	
<u>Review Unit 2 Objectives</u> 1. Describe Methodology. 2. Define terms used in origin and cause determination. 3. Identify the processes in origin and cause methodology. 4. Describe methods used to identify and process an "Ignition Area."	02-96-FI210-EP
Answer students' questions.	

UNIT OVERVIEW

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 3 – Fire Scene Evidence

Time 1 Hour

Objectives

1. Describe the types of physical evidence associated with a fire investigation.
2. Describe the legal requirements to maintain evidence admissibility.
3. Recognize how a variety of photographic techniques can be used in the collection and documentation of evidence.
4. Recognize the methods for documentation, collection, storage, and maintaining chain of custody.
5. Describe the various techniques of and differences between sketching and diagramming fire scenes.

Instructional Method(s)

- Informal lecture
- Classroom discussion

Instructional Aids

- ☐ Computer with projector, screen, and presentation software
- ☐ Sign-in sheet
- ☐ Flip charts and markers

UNIT PRESENTATION

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 3 – Fire Scene Evidence

OUTLINE	AIDS & CUES
Present unit title slide. Present unit objectives.	03-01-FI210-EP 03-02-FI210-EP
1. Describe the types of physical evidence associated with a fire investigation. 2. Describe the legal requirements to maintain evidence admissibility. 3. Recognize how a variety of photographic techniques can be used in the collection and documentation of evidence. 4. Recognize the methods for documentation, collection, storage, and maintaining chain of custody. 5. Describe the various techniques of and differences between sketching and diagramming fire scenes.	

OUTLINE	AIDS & CUES
TYPES OF EVIDENCE:	03-03-FI210-EP
• Evidence is classified into two broad categories: – Direct – Circumstantial • Evidence is further categorized by type: – Testimonial – Real: physical or documentary – Demonstrative and Judicial Notice or Indirect	
Direct Evidence:	03-04-FI210-EP
• Testimony of witness who sees the criminal act. – A witness observes the defendant at the scene, setting the fire. – Other senses also apply.	
Circumstantial Evidence:	03-05-FI210-EP
• Tends to prove a fact in dispute indirectly. – Tire prints that match the defendant's vehicle are recovered at the scene. – DNA is recovered from an arson device.	

OUTLINE	AIDS & CUES
• Eyewitnesses to wildland fires are an infrequent occurrence. • Most case will rest on circumstantial evidence.	
<u>Testimonial Evidence:</u> • Evidence which is testified to by a witness. – Firsthand knowledge – Observed or experienced o Witness observed defendant light burn barrel. o Witness smelled smoke. o Witness heard fireworks. o Witness saw tire tracks. – Direct or Circumstantial	03-06-FI210-EP
<u>Real or Physical Evidence:</u> • A tangible item or object • Used to establish a fact – Footwear impression, ignition source, etc.	03-07-FI210-EP

OUTLINE	AIDS & CUES
Demonstrative Evidence:	03-08-FI210-EP
• Documentary – Burning permits, ownership maps, etc. – Models, charts, and graphic aids	
• Judicial Notice – Evidence substitute – Facts that are common knowledge o Independence Day always occurs on July 4 and a match applied to dry grass will likely ignite it.	
Most fire cases will rely primarily on physical and testimonial evidence.	
ADMISSIBILITY OF EVIDENCE:	03-09-FI210-EP
• Relevance: – Evidence must have some connection to the facts of the case. – Must be pertinent to the issues of trial. – Must assist the trier of fact in proving facts in dispute.	

OUTLINE	AIDS & CUES
• Authentication and Identification: – Competent – Same item – Not tampered with, altered or contaminated	
<u>Methods to Ensure Competence:</u> • Exclusive custody and control in a secured area. • Maintain a complete written record of chain of custody. – Evidence tag • Marked in a distinctive manner.	03-10-FI210-EP
ADMISSIBILITY OF EVIDENCE: Evidence may be admissible provided it was obtained legally under one or more of the following circumstances: • Non-private area – Evidence in open fields or public lands. • Plain view – Immediately recognized as incriminating. – Observed by an official who was legally present.	03-11-FI210-EP

OUTLINE	AIDS & CUES
• Exigent Circumstances – Emergency circumstances exist that could cause destruction or loss of evidence.	03-12-FI210-EP
• Consent – Where there is an expectation of privacy, a person who has a controlling interest in the area to be searched may give their consent to authorities.	
• Abandonment – Abandoned by owner – Not recommended, difficult to establish proof – Consult with prosecutors	03-13-FI210-EP
• Warrant (Criminal or Administrative) – A court order directing the investigator to search for and seize specific items. o Preferred method – Some jurisdictions allow for an administrative warrant. o Legal justification needed is substantially less than a criminal warrant.	03-14-FI210-EP

OUTLINE	AIDS & CUES
In most wildland fire investigations, the investigator can expect to recover the majority of evidence from private areas under the Plain View Doctrine and/or exigent circumstances.	
Michigan v. Tyler (1978):	03-15-FI210-EP
Supreme Court established legal authority for fire investigators to conduct a warrantless search for evidence of the cause and origin of a fire. • Public safety concerns • Exigent circumstances	
Note: Fire officials investigated a fire while it was still burning. They re-entered building the following morning after temporary interruption due to safety and visibility concerns and found evidence of arson. They further re-entered over next several weeks. Case was challenged on grounds that re-entry was unconstitutional. First two morning entries legal Subsequent entries illegal and evidence suppressed.	
Michigan v. Tyler (1978):	03-16-FI210-EP
• Court held that while a fire is still burning and under control of fire department a warrantless entry to determine the cause of the fire is reasonable. • Evidence in plain view may be seized. • Temporary interruptions due to hazards, poor visibility, etc., allow for subsequent warrantless re-entry within “a reasonable time period” (no bright-line rule).	

OUTLINE	AIDS & CUES
• Absent "exigency of sufficient proportion," re-entry must be by consent or warrant.	
Note: If you must come back the next day, have the property owner sign consent to enter form. Consult with local law enforcement or DA.	
Michigan v. Tyler (1978):	03-17-FI210-EP
How might Michigan v. Tyler affect wildland fire investigations?	
• On public lands	
• On private lands	
• Curtilage	
Michigan v. Clifford (1984):	03-18-FI210-EP
The court further defined legal parameters regarding the legality of an origin and cause investigation conducted after an emergency or exigent circumstances cease.	
Note: Fire in private residence. Investigators arrived five hours after fire suppression had left scene. Investigators found evidence of arson at origin area and additional evidence in an area well away from the origin. No warrant or consent.	

OUTLINE	AIDS & CUES
Michigan v. Clifford (1984):	03-19-FI210-EP
• Search was ruled unconstitutional and motion to suppress granted.	
• How might Michigan v. Clifford affect wildland fire investigations?	
– Public lands	
– Private lands	
– Curtilage	
United States v. Jones (2013):	03-20-FI210-EP
The court found for some of the evidence to be suppressed due to the GPS tracking device being considered a "search" and proper avenues were not obtained.	
Note: No warrant or consent had been obtained.	
United States v. Jones (2013):	03-21-FI210-EP
• Evidence garnered was ruled unconstitutional and motion to suppress granted.	
• How might U.S. v. Jones affect wildland fire investigations?	
– Public lands or properties	
– Private lands or properties	
– Curtilage	

OUTLINE	AIDS & CUES
EVIDENCE COLLECTION AND PRESERVATION PROCEDURES:	03-22-FI210-EP
Non-Fragile Fire Cause Objects:	
Items that are less subject to damage from heat, flame, or damage when collected:	
• Metal fragments	
• Catalytic converter matrices	
• Welding slag	
• Power line hardware	
Non-Fragile Fire Cause Collection Procedures:	03-23-FI210-EP
• Carefully pick up and place in folded paper bindle or other suitable packaging.	
• Place into hard sided container.	
• Pack in cotton to keep fragile edges from breaking off.	
• Seal and tag.	
Fragile Fire Cause Objects:	03-24-FI210-EP
Objects that can be easily damaged or destroyed during the collection process:	
• Cigarette remains	
• Matches	
• Fusee slag	

OUTLINE	AIDS & CUES
• Fireworks remains	
• Arson devices	
• Exhaust carbon	
Basal Area Lift Technique:	03-25-FI210-EP
Prevents damage to fragile items.	
• Shovel or trowel (clean)	
• Thin piece of flexible sheet metal	
• Score line through ash and duff, down to soil around the object	
• Leave border of several inches surrounding the object	
Liquid Accelerant Residue:	03-26-FI210-EP
• Obvious signs of trailers and pour patterns: puddles, deep seated burning, scorching or soot.	
• Gasoline and diesel have strong odor.	
• Deodorized kerosene, lighter fluid, alcohol and others may not be detectable by smell.	
• Search perimeter areas.	

OUTLINE	AIDS & CUES
Liquid Accelerant Residue Detection:	03-27-FI210-EP
• Hydrocarbon detectors	
• K-9 units	
Sampling Locations for Liquid Accelerants:	03-28-FI210-EP
• Focus on areas that had a lower intensity fire.	
• Porous items such as deep compacted duff, punky logs, and stumps.	
• Soil samples are also good.	
• Tests determined detectable residues in soil could remain up to 162 hours after the fire.	
• Microbial action may degrade sample quickly.	
Note: Some resent investigation sources in Canada indicate that liquid accelerant remains may be found in some soils and woody materials years after being placed there.	
Liquid Accelerant Collection Procedures:	03-29-FI210-EP
• Secure suspected charred wood or vegetation.	
• Fill can approximately 2/3 full.	
• Avoid cross-contamination.	
• Clean tools.	
• Try to use unlined cans if processed quickly.	

OUTLINE	AIDS & CUES
• Have unused can available for control sample at lab.	
• If delay of more than several hours in getting sample to lab, samples should be frozen.	03-30-FI210-EP
– Metal evidence containers or glass	
• Familiarize yourself with servicing lab procedures.	
Note: Unlined cans may rust or corrode if on shelf for long period of time if lab has back log.	
• Containers found near, or at fire scene, should be collected.	
• If liquid is still present, pour a small sample into a clean container with an airtight seal.	
• Seal and mark the container, hand carry to lab.	03-31-FI210-EP
• If it will be several hours, store in a cool place.	
• Most crime labs will be able to isolate ignitable liquids by means of GC/MS analysis and other tests.	
Note: GC = Gas Chromatograph, MS = Mass Spectrometer	
<u>Firearms:</u>	03-32-FI210-EP
Note: This slide introduces Firearms related evidence handling.	

OUTLINE	AIDS & CUES
<u>Projectile Evidence:</u> • If lodged in wood or other material, leave in material and take whole portion to lab. • If bullet is recoverable, do not attempt to clean it. • Wrap it separately in a paper bindle. – Place on cotton padding in a hard sided container – Seal and mark Note: Leave bullet in material and take whole portion as evidence. Example: If in board take section of board with bullet in it as evidence, do not remove bullet.	03-33-FI210-EP
<u>Cartridge Cases:</u> • Wrap each case in a separate paper bindle. – Seal in separate hard sided container – Mark accordingly • If comparison to a firearm is necessary, submit both to lab. • Never submit a loaded firearm to a lab unless it is delivered in person with advance approval of the lab.	03-34-FI210-EP
<u>Shoe and Tire Impression Collection Procedures:</u>	03-35-FI210-EP

OUTLINE	AIDS & CUES
If possible, photograph with:	03-36-FI210-EP
• Tripod to position the camera directly over the impression. Use a normal lens (50 mm).	
• Linear scale next to and on the same plane as the impression.	
• Set the f-stop on f/16 or f/22 for a greater depth of field.	
• Flash at a very low angle (10-15 degrees) to the impression. This will enhance the detail of the impression.	
• Shoot several photos, move the flash two or more angles to the impression.	03-37-FI210-EP
Note: Find out what your local lab prefers. Consider using black and white settings as well as various angles and shadowing.	
• Cast with dental stone	
• Shoe impressions should usually be cast	
• Casting of a tire impression is problematic	
– Difficult to match impressions to an individual tire	
– Effort involved is significant	
• Most crime labs prefer photographic documentation of tire impressions.	03-38-FI210-EP

OUTLINE	AIDS & CUES
• Once cast is made, do not clean it off. Wrap the cast in tissue, dirt and all. Place in a cotton padded box, pack securely, seal and mark accordingly.	
Note: Recommended to cast entire revolution of tire impression when appropriate and feasible.	
<u>Fingerprint Collection Procedures:</u>	03-39-FI210-EP
• Fingerprint evidence may remain after fire.	
• Prints have been recovered from beverage containers, food wrappers, cigarette packs, and arson devices.	
• Handle object so as not to add extra prints to it.	
• Package objects in a box so that they will not break or roll around.	
• Do not package in plastic.	
Note: Recommended not to package in plastic because of "sweating" and evidence sticking to package losing integrity.	
<u>DNA Evidence Collection Procedures:</u>	03-40-FI210-EP
• Polymerase Chain Reaction (PCR) test and mitochondrial DNA test have increased the likelihood of recovering usable DNA, even on heat-damaged items.	

OUTLINE	AIDS & CUES
• Potential sources of DNA evidence: – Hair – Blood – Semen – Saliva	
Note: DNA has been obtained off of cigarette match devices years later. DNA has been obtained from rocks thrown through windows on other crimes as well.	
• Consider anything that may have been contacted: – Beverage containers – Clothing – Cigarette/match devices – Food	03-41-FI210-EP
• Collect in clean paper or envelope with sealed corners.	
Contamination is a big issue. Remind students about using fresh gloves on each piece of evidence/sample collected.	
• Do not use plastic containers. • Avoid cross contamination.	03-42-FI210-EP

OUTLINE	AIDS & CUES
• Collect each item with new gloves. • Use sterile forceps/tweezers. • Submit DNA evidence to the lab as soon as possible.	
<u>Miscellaneous Evidence:</u> • Paint Transfers • Blood stains • Hair and fibers • Glass fragments • Soil • Tool marks	03-43-FI210-EP
<u>Photography:</u> Provides: • Facts and physical circumstances of evidence visually • Preservation of perishable evidence • Consideration of evidence which cannot be transported into a courtroom, because of immobility, size, weight, etc. • Verification for your testimony • Facts or evidence that you may have overlooked	03-44-FI210-EP

OUTLINE	AIDS & CUES
Note: Evidence should be photographed in place prior to moving and as found. This should include photos that show the location where the evidence is in relationship to other key features of the scene and close-up photographs that show the details of the item to be collected and the area immediately around it. The evidence should then be photographed with a scale in close proximity, being careful not to touch or contaminate the evidence item. During the collection of evidence, it may be useful to photo document the evidence recovery process, this can be accomplished both using photography and videography. This documentation may include the methods used for collection, the tools used, and the container used, including markings on the container identifying the evidence item. After collection, when it is safe to do so, and when it is necessary, better quality photographs of an evidence item may be taken once the evidence has been moved to a safe location. Blue background paper may be used to place the evidence item on for better contrast. These photos may include comparison evidence items as long as cross contamination is avoided.	
<u>Videography:</u> Provides: • Overall crime scene footage • Surveillance • Supplemental photographs	03-45-FI210-EP

OUTLINE	AIDS & CUES
• Documentation of interviews and interrogations • Exclusive use not recommended	
Review Unit 3 Objectives.	03-46-FI210-EP
1. Describe the types of physical evidence associated with a fire investigation. 2. Describe the legal requirements to maintain evidence admissibility. 3. Recognize how a variety of photographic techniques can be used in the collection and documentation of evidence. 4. Recognize the methods for documentation, collection, storage, and maintaining chain of custody. 5. Describe the various techniques of and differences between sketching and diagramming fire scenes.	
Answer students' questions.	

UNIT OVERVIEW

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 4 – Witness Interviewing

Time 1 Hour

Objectives

1. Know the difference between an interview and an interrogation.
2. Understand when and where to conduct witness interviews.
3. List the various methods of obtaining witness information and statements.
4. Describe the witness interview process.
5. Know the guidelines for conducting witness interviews.

Instructional Method(s)

- Informal lecture
- Classroom discussion

Instructional Aids

- ☐ Computer with projector, screen, and presentation software
- ☐ Sign-in sheet
- ☐ Flip charts and markers

UNIT PRESENTATION

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 4 – Witness Interviewing

OUTLINE	AIDS & CUES
Present unit title slide Present unit objectives.	04-01-FI210-EP 04-02-FI210-EP
1. Know the difference between an interview and an interrogation. 2. Understand when and where to conduct witness interviews. 3. List the various methods of obtaining witness information and statements. 4. Describe the witness interview process. 5. Know the guidelines for conducting witness interviews.	
Question to Class (QTC): Has anyone ever conducted a witness interview? • Quite often not much time to prepare. Have to think on your feet. • Skill improvement comes with repetition. QTC: Has anyone ever conducted an interrogation of a suspect?	

OUTLINE	AIDS & CUES
OVERVIEW:	04-03-FI210-EP
• Physical evidence can only provide part of the overall investigation.	
• At some point, it may be necessary to interview witnesses, victims, or suspects.	
• Interviews add weight and meaning to evidence.	
• Witnesses provide basis for further investigation.	
• Conduct interviews in a professional manner.	
Note: Examples of physical evidence: pop can, disposable lighter, vehicle.	
QTC: What is the difference between a witness, a person of interest and a suspect?	
• As an origin and cause investigator, you may interview witnesses.	04-04-FI210-EP
• Know your agency policy re: conducting witness interviews.	
• The quality of interview technique governs quality of information obtained.	
Note: Typically, poor interviews will require a follow-up interview. Must first be able to find the person to re-interview.	

OUTLINE	AIDS & CUES
• The interview can be an important tool in conducting the overall investigation. • You may only get one chance to do it right, so do it right the first time! • Take additional training courses on interviewing. • PLAN AND PREPARE FOR THE INTERVIEW.	04-05-FI210-EP
INTERVIEW VS. INTERROGATION • The main responsibility of an INVF is to establish origin and cause. • Need for interrogation may arise during this process. – Consider requesting a qualified law enforcement investigator. – Legal and strategic complexities involved that are likely to fall beyond the scope of your training and experience.	04-06-FI210-EP
First responder contacting suspect (not their mandate to interrogate) – get particulars, make observations and notes. • Requires experience and training to be effective at interrogation. • Increase odds of successful if interrogation is in proper setting i.e., interview room.	

OUTLINE	AIDS & CUES
• Interview – Detailed questioning of a subject, most often a witness. – No Miranda warnings required. • Interrogation (also called 'Forensic Interview') – Process of inquiry that seeks admissions or confessions to establish guilt. – Miranda warning may need to be addressed. – Obtain qualified help to conduct an interrogation.	04-07-FI210-EP
Note: Need to have prior partnerships established between LE and fire.	
<u>Legal Miranda Requirements:</u> • A suspect being questioned by law enforcement regarding a crime they may have committed, AND the subject is or perceives they are in custody and/or being detained. • Investigators should follow their agency guidelines regarding the questioning and interrogation of subjects!	04-08-FI210-EP

OUTLINE	AIDS & CUES
Note: Witnesses are not detained and therefore are free to leave when they wish. Explain USA Miranda warnings or Canadian Charter of Rights + Freedoms. Courts take this very seriously. A breech of Miranda or Charter rights can seriously jeopardize your case!	
QTC: Are Fire Staff in coveralls with visual identifying crests considered as a person in authority? Answer: Yes	
WITNESSES	04-09-FI210-EP
Who Can Be a Witness?	
In most cases witnesses can take the form of:	
• Voluntary witness (reports the incident)	
• Unknowing and voluntary witness (saw/heard something but did not realize there was any offense)	
• Reluctant witness (doesn't really want to be involved for variety of reasons)	
• Hostile witness (won't speak to you)	
QTC: Who gives the most accurate information of the four classes of witnesses? **Answer**: The first two (with voluntary witnesses being the best).	

OUTLINE	AIDS & CUES
<u>Possible Witnesses:</u> • First responders (fire, medical, LE) • By-standers • Reporting party • Local residents • Property owners • Recreationists • Local resource users • Dispatchers • Workers in area (Postal employees) • Airborne personnel, lookouts	04-10-FI210-EP
Note: The list goes on and on…	
<u>Format to Record Witness Information:</u> • Written – Pure version then follow up with Q & A's for clarification. – Agency witness statement form. • Digital Recorder • Videotaped	04-11-FI210-EP

OUTLINE	AIDS & CUES
• Investigator's field notes of conversation with witness – Least preferred if that's the only record of the interview.	
Note: A pure version statement is getting the witness' statement without contaminating them with your words. Let them tell their story without influence from the interviewer. The subject should be doing 70 – 90% of the talking during the information-gathering phase of the interview. Obtain identification including physical home address and all phone #'s. Beware of box #'s.	
INTERVIEWS <u>What Is a Witness Interview?</u> • Information gathering. • Permanent record of witness' recollection—less likely to alter/recant. • Non-accusatory. • From witnesses, victims (and sometimes suspects). • Any person who may have evidence surrounding circumstances of the fire.	04-12-FI210-EP

OUTLINE	AIDS & CUES
Note: Who? What? Why? Where? When? How? • What did they hear, see, and/or smell? • Eliciting information from: suspect, witness, complainant/victim, and/or informant. • People are affected by numerous physical and emotional factors which can color and question the information given to the officer. Emotions may cause a person to give prejudicial information, to lie or to forget events.	
• Finding out the 5W's and How. • Low time factor, usually 20-40 minutes. • Can be used by witness later to refresh memory. • Purpose is to elicit usable information to assist in the investigation.	04-13-FI210-EP
<u>When To Conduct Witness Interviews:</u> Witness statements should normally be taken as soon as possible to ensure that: • Events are still fresh in the mind of the witness. • Evidence is recorded before the witness' version of events is "tainted" by discussing their evidence with others.	04-14-FI210-EP
<u>Location of Interview:</u> • Variable environments, e.g., in the field, vehicle, office, subject's house.	04-15-FI210-EP

OUTLINE	AIDS & CUES

- Interview privately and separately (no "group interviews").
- Reduce distractions (choose appropriate location).
- Not in presence of co-workers or friends.
- Make it as easy for the witness as possible—his/her schedule not yours.

QTC: Why would you not interview two witnesses at once?

- Privacy is paramount to ensure no cross contamination of witnesses. Witnesses who hear other witness testimony may be swayed to go with what the other witness said.
- Depending on circumstances, the location of the statement will vary but it should still possess some of the same characteristics. You may be forced to take the statement in your truck, at a logging operation camp, etc. Be prepared by having extra batteries/tapes for your tape recorder, video.
- The location of the interview should be private and without distractions. Discuss with the witness where the interview will take place to ensure it will meet his/her needs of privacy. You may in these cases phone ahead and decide to meet at a time and location where the witnesses anonymity is ensured.

OUTLINE	AIDS & CUES
Note continued: • The witness should not be inconvenienced if at all possible. If he wants to have an early morning meeting because it suits him and his schedule do so. This will also demonstrate that you are interested in his information and that you respect his wishes thereby establishing some trust and confidence.	
<u>Guidelines for Conducting Witness Interviews:</u> Interviewer: "The purpose of this interview is to see what you have to contribute to this investigation. I wasn't there. You were. I need you to tell me exactly what happened."	04-16-FI210-EP
Note: • As further encouragement the interviewer might say, "Please tell me everything that happened, and don't leave anything out, and don't make up anything if you don't know." • The end goal is to reinforce to the witness the importance of co-operating and the fact that he or she may have critical information that is critical to solving the crime. • Our main goal is to find out the truth—if a witness observed it we want to know the details of what he/she knows re: the incident.	
• Identify yourself. • Explain purpose of interview.	04-17-FI210-EP

OUTLINE	AIDS & CUES
• Know your agency protocol for interviewing persons of the opposite gender. • Record identification and contact information before beginning the interview.	
Note: • Brief interviewers that do not have a working knowledge of fire as to what questions to ask. • **Know your agency protocol for interviewing persons of the opposite gender.** Generally for men interviewing a female witness, have another male or female investigator present. • Obtain the physical address as well as the mailing address of the witness. • If the witness says they don't have a phone, then ask them for a phone number of a contact person for them, i.e., parents, friend, work. • Obtain complete legal name, e.g., Robert vs. Bob.	
• Ask witness not to guess—personal observation only.	04-18-FI210-EP
• Investigator should control the interview.	
• Establish rapport/trust.	04-19-FI210-EP
• Allow subject to talk (80/20 principle).	
• "Art of active listening."	
• Let them tell their story, without influence from the investigator.	

OUTLINE	AIDS & CUES
Note: • Lighting, distance from the incident or physical limitations may result in an inaccurate interpretation of the events observed. Explore all the circumstances surrounding their evidence/recollection without leading and prompting the witness. You want it to be their story not influenced by you. • Allow subject to talk (80/20 principle). In an interview the subject should talk about 80% of the time and the interviewer about 20%. • "Please tell me in as much detail as possible about…"	
• Ask witness to mentally recreate circumstances, chronological timeline is best. • Questions may be interjected to get them back on track. • Ask if witness has photos or video of the incident.	Slide 4-20-FI210-EP
Note: Specifically ask about photos taken with phones. Follow up soon with fire suppression personnel, before they are demobilized or sent to another incident. Ask if anyone else was present who may have seen the same thing. Ensure that the person(s) conducting the interviews are relaying the information from the interviews to the person who is briefing the investigative team. Complete and accurate flow of information is critical to the success of the investigative team.	

OUTLINE	AIDS & CUES
If witness saw wildfire, ask specific details regarding fire behavior upon arrival: • Fire perimeter size • Exact location • Wind direction • Color of smoke • Material fire was burning in (i.e., grass, brush, timber)	04-21-FI210-EP
Note: • If witness saw wildfire, ask specific details re: fire behavior upon arrival: Be aware that very often witnesses will tell you the location <u>where they saw flames</u>, and they'll strongly believe that's where the fire started. • Keep in mind when questioning about fire size to be specific, otherwise witness will likely discuss smoke plume size, flame size. • If multiple fires, question the size of the smoke columns to help determine sequence of ignition.	
• Obtain pure version, then Q + A's for clarification. • Use open-ended questions. • Have witness draw out sketch or map. • Consider taking witness back to event scene.	04-22-FI210-EP

OUTLINE	AIDS & CUES
Note: • Pure version: "Start at the beginning and tell me everything." • Ensure you understand exactly what the witness is telling you. • Examples of open-ended questions: "What can you tell me about the truck?", or "Tell me what happened next." or "Can you provide details as to what this person looked like?" or "Please tell me more about…" • Consider taking witness back to event scene: It's a good practice to bring the witness back to the event (or crime) scene, and video-tape his/her statement where physical objects and or presence can be used to "jog the memory."	
<u>Avoid:</u> • Being in a rush. • Being authoritative or overbearing. • Using leading questions. • Asking compound questions. • Using questions that elicit short answers. • Interrupting the subject. • Negative questioning. • Leading the witness in any direction or force them to stay on one subject.	04-23-FI210-EP

OUTLINE	AIDS & CUES
Note: • Example of a leading question: "Was he driving a red pickup?" or "Would you agree that the subject failed to properly extinguish his campfire?" • Example of compound question: "What did you see upon arrival at the fire scene AND did you happen to watch the media coverage on the evening news regarding the fire?" • Example of negative questioning: "I don't suppose you recall what he was wearing, do you?"	
• The investigator may assist the subject in drafting the written statement. • Have the witness review and acknowledge corrections. • Start and end times.	04-24-FI210-EP
Note: When you write or draft a witness statement, make sure that they can read and write what you have written. Signing of a statement shows personal ownership. Original statement maintained in lead investigator's file.	
<u>Summary and Closure:</u> • Summarize, review, and re-affirm key responses. • Ask specific questions on key points witness did not voluntarily provide.	04-25-FI210-EP

OUTLINE	AIDS & CUES
Note: • Reaffirming key points will ensure their accuracy. • Reaffirming key points will make the points solid when being scrutinized in court down the road, i.e. "Tell me again what the license plate number was? Describe the suspect with as much detail as possible."	
• At end of interview ask "Is there anything else important that we've missed or that you haven't told me about?" or "What else should I have asked you about that I haven't asked?"	04-26-FI210-EP
• At end of interview ask "Who else may have additional knowledge?"	
• Leave contact information in case they recall something important.	
<u>Impaired or Hostile Witness:</u>	
• Witness impaired by alcohol or drugs should be interviewed later.	04-27-FI210-EP
• Angry or hostile subjects may escalate the interview into a more aggressive encounter.	
– Have an additional investigator or law enforcement officer accompany you during such contacts.	

OUTLINE	AIDS & CUES
Non-English or Mentally Challenged: • Non-English speaking subjects will require a translator. • Mentally challenged individuals may require special interview techniques and assistance.	04-28-FI210-EP
Field Notes: • Investigator should summarize key points of each witness interview in field notebook. Notes are subject to discovery.	04-29-FI210-EP
Juveniles as Witnesses: • You may have contact with juveniles on wildfire investigations. • Knowledge and consent of the parent or legal guardian may be required. • Follow agency policy in handling juveniles as witnesses or suspects.	04-30-FI210-EP

OUTLINE	AIDS & CUES
Note: • Gather juvenile particulars, including information re: parents and guardians. • It's O.K. to take a witness statement from a juvenile. • Information may be used to further investigation as opposed to being entered in court. • Juvenile suspects must be dealt with differently than adults.	
<u>Witness List:</u> • Investigator should develop and maintain witness list. • Follow agency guidelines and format.	04-31-FI210-EP
Note: • Investigator's responsibility. • First Responder will provide witness particulars to investigator.	

OUTLINE	AIDS & CUES
Witness Now A Suspect? If for various reasons you believe your witness is now a suspect, follow agency policy on referring this information to LE for follow-up.	04-32-FI210-EP
Note: • Demeanor, facts don't line up, subject has too much specific information about the ignition. • Make note of questions the subject asks you.	
Review Unit 4 Objectives	04-33-FI210-EP
1. Know the difference between an interview and an interrogation. 2. Understand when and where to conduct witness interviews. 3. List the various methods of obtaining witness information and statements. 4. Describe the witness interview process. 5. Know the guidelines for conducting witness interviews.	
Answer students' questions.	

UNIT OVERVIEW

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 5 – Documentation

Time 2 Hours

Objectives

1. Recognize what needs to be documented in a wildland fire investigation and when to document it.
2. Determine appropriate methods to document.
3. Determine the items that may be included in an investigative/case file.
4. Understand how to fully complete an origin and cause report.
5. Understand the roles of an INVF and/or case agent/case manager and how they interact.

Instructional Method(s)

- Informal lecture
- Classroom discussion

Instructional Aids

☐ Computer with projector, screen, and presentation software
☐ Sign-in sheet
☐ Flip charts and markers

UNIT PRESENTATION

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 5 – Documentation

OUTLINE	AIDS & CUES
Present unit title slide. Present unit objectives.	05-01-FI210-EP 05-02-FI210-EP
Field documentation forms the foundation for the investigative/case file. This unit will address field documentation first, and then discuss the investigative/case file. Key point: Documentation is only as good as the information/data that is collected. Poor gathering of information will often lead to incomplete documentation which may result in a less than successful investigation and later testimony.	
Unit 5 Objectives: 1. Recognize what needs to be documented in a wildland fire investigation and when to document it. 2. Determine appropriate methods to document. 3. Determine the items that may be included in an investigative/case file. 4. Understand how to fully complete an origin and cause report. 5. Understand the roles of an INVF and/or case agent/case manager and how they interact.	

OUTLINE	AIDS & CUES
Note: Documentation Needs: Can only be determined through the complete and accurate collection of data. Documentation Methods: Most well documented investigation relies on multiple methods to document the data collected. Documentation Items: A case file may be more than a simple paper report. A case file can include all types of information and include data which is produced well after the initial report is written. Document origin and cause report: How does the investigator tell the story of what happened? Minor details at the time of the report writing may become more important over time as new data comes to light which may make it essential to have documented what had seemed like a minor point. Roles of INVF and Case Agent/Manager: Each agency may name these positions differently and may make the same or different persons responsible for these rolls. It is important for the investigator to understand what responsibilities they have for each assignment.	
<u>Documentation: Purpose</u> • True and accurate representation of the investigation. – Sufficient detail – Describes findings and explains conclusions.	05-03-FI210-EP

OUTLINE	AIDS & CUES
• Memorializing the facts. • Allows the investigator to recall and communicate their observations at a later date.	
Note: Field gathering of data and its documentation forms the foundation for the investigative/case file. This unit will address some elements of field documentation, and then discuss the investigative/case file. The recommendations in this unit are not all inclusive. The instructor may ask the students to participate and add additional comments concerning documentation. The major point to emphasize is the need to document what is observed, heard or done, and maintain the documentation in a readily available location.	
<u>Possible Outcomes:</u> • Administrative • Civil • Criminal • Continuing investigation Approach the documentation so that it is sufficient for all possible outcomes or applications.	05-04-FI210-EP

OUTLINE	AIDS & CUES
Note: Any of the listed possible outcomes can take weeks, months, and often years to develop. Good documentation is the cornerstone of being able to convey the information of the investigation accurately over an extended period of time. Trusting your memory for a period of years can be a risky proposition and often results in the investigator looking less than professional and/or reliable.	
<u>Documentation:</u> • The investigator • Other investigators – Participating and/or follow-up investigators – Expert/peer reviews • Prosecutors and defense • Third party interests • Agency administrators	05-05-FI210-EP
Note: • Civil and criminal fire cases can span a period of many years. • Documentation is a critical process that enables the investigator to refresh their memory and provide testimony. • Documentation allows for other investigators to follow-up on your work.	

OUTLINE	AIDS & CUES
Note continued: • Documentation forms the basis for expert review of the investigation. As well as defense and forensic review. • Documentation forms the basis for peer review of the investigation. • Prosecutors will rely on the documentation of the investigation for almost all of their actions in a case. • Third party interests, including citizens who may have been damaged or harmed by the fire, will rely on the documentation of the investigation to recover their damages. • Administrators will use documentation of fire cause and ignition sequence to take administrative, fire prevention or collection actions	
<u>Documentation – Terminology:</u> • Recommended use of terminology, such as "General Origin Area," "Specific Origin Area," and "Ignition Area." • If a term is not being used in the recommended context, or if another term is being used, define it in your report. • Be consistent in how you use terms in your notes, sketches, diagrams, and reports.	05-06-FI210-EP

OUTLINE	AIDS & CUES
Note: FI-210 provides recommended terms for use in describing some of the features of a fire investigation. The use of these terms are not mandatory or all inclusive, but are recommended for consistency.	
Documentation:	05-07-FI210-EP
Categories: • Field Notes • Interviews/Statements • Sketches/Diagrams – Photo points and direction – Fire patterns – Fire progression vectors – Measurements • Photography – Photos, video and photo log – Metadata • Report	
Note: Documenting the scene *falls under five main categories* and can occur in various forms; written field notes, photographs, sketches, and the final report. The investigator can use various combinations of these methods to document the scene.	

OUTLINE	AIDS & CUES
Note continued: Advise students that they may want to use a digital recorder or other such recording device for their notes. Recording may be discoverable. Check your agency policy. *Field notes may include documentation of the actions you took, the ongoing timeline of your actions, identity of individuals related to the fire investigation, etc.*	
<u>Documentation - Field Notes:</u> Field Notes is a continuous and inclusive process that includes information about: • Photographs • Sketches • Measurements • Evidence Log • Witness Statements • Other data	05-08-FI210-EP
Note: The extent to which an investigation will need different types and levels of documentation is dependent upon the specifics of each fire scene and the assignment of the investigator. All types of documentation used alone and in combination assist in tying the data and facts of the case together.	

OUTLINE	AIDS & CUES
Note continued: Basic photography of all scenes is accomplished through the use of digital cameras widely available today Sketches are rough in nature and serve to orient the reader of the report and document locations of items of interest. Measurements of features and items of interest can be documented by multiple methods including field notes, sketches, and photography. Field notes will form the basis for any final written report and can be supported through the use of photography, sketches, witness statements, etc. Evidence logs help to document details of evidence location, collection, and storage. Witness statements may be documented on agency specific forms. Follow your agency policy concerning the use of, and retention of field notes.	
<u>Documentation - Field Notes:</u> Receive the Assignment • Timeline (chronology) • When you got the call/responded. • What is your assignment and responsibility? – Reports you are expected to produce.	05-09-FI210-EP

OUTLINE	AIDS & CUES
• Who notified you? • What is reported to you/dispatch/suppression information? – Time fire first reported. – Reporting party(s) (Witness/Responsible)	

Note: The timeline is the general document you keep, that may be kept in addition to the other field notes. Regardless, documentation is an ongoing process starting from the time you receive the assignment.

Things that do not seem important at the time, may become significant later on.

Documentation is continuous through to case conclusion.

You will often be questioned about when you were first called, when you responded, how long it took you to respond, what route you took in responding, what the nature of your assignment was, who or how you were notified of the assignment, and what they told you.

Consider asking questions during this phase to begin the data collection process. (i.e., time the fire was first reported, reporting party name and contact information, witness information, first fire department resources at the scene.)

When practical start writing things down immediately rather than trying to recreate what happened.

OUTLINE	AIDS & CUES
Documentation - Field Notes: As practical, document the following while en route to scene (chronology). • Reports on fire condition/initial attack report. • Observations – Suppression activity – Ingress/egress routes (e.g. gates, tire tracks)	05-10-FI210-EP
Note: Ask the students for input about other things they have documented enroute to a fire scene. Radio traffic during your response can yield valuable tips concerning the fire location, access, behavior, size, direction of spread. Observations of suppression activity, condition of access and egress routes, vehicles in the area, witnesses, and activities in the area, smoke column, wind conditions, and any changes that occur over time can be of importance to the investigation of the fire. The investigator may be questioned regarding their initial observations and have to give testimony.	
Documentation - Field Notes: Observations (cont.) • Vehicles/witnesses • Activities in area	05-11-FI210-EP

OUTLINE	AIDS & CUES
• Smoke column, size, color, direction of drift, changes (photograph) • Wind conditions; changes in weather • Evidence: gates, tire tracks, foot impressions	
Note: You have to make the observations to be able to document them. Think about this while responding and when you arrive on scene. The more complete the observations are, the more likely your documentation will be complete.	
Documentation - Field Notes: Arrival at Scene	05-12-FI210-EP
As practical document the following: • Fire perimeter • Location • Suppression activities/land use activities • Direction of spread • Fire intensity	
Note: Document your arrival time. Recognize where the fire is actively burning upon your arrival; this may later help you determine your general origin area. This may include the size, active fire area, location/boundary, suppression activities, direction of spread, fire intensity, fuels, topography, weather, and other observations.	

OUTLINE	AIDS & CUES
Note continued: Do not assume that someone else has taken down this information prior to your arrival. Don't rely on suppression crews to provide you with this information because most suppression resources will be focused upon their assignments and may not see the overall picture.	
Documentation - Field Notes: Arrival at Scene (cont.) • Fuels • Topography • Witness information • Weather: – Most valuable when taken soon after ignition and near the origin. – Obtain weather data from IA personnel.	05-13-FI210-EP
Note: The purpose of taking weather readings is to provide the most accurate weather conditions at the origin of the fire at the time of ignition. Try to get as close to the origin time and location as possible when taking weather readings. It may be helpful to also take wind and other weather readings along ridgelines near the origin to provide data for large scale progression of the fire and to show the effect of different wind patterns on the various terrain. Consider documenting the location, with a GPS or other means, of where the weather readings were taken from.	

OUTLINE	AIDS & CUES
Note continued: The value of weather readings may diminish as time passes after the fire ignition. The investigator should take weather data on scene even when they arrive later. This later data may be representative and/or may be used to compare to RAWS stations to determine which station may be representative of conditions occurring at the scene.	
<u>Documentation - Field Notes:</u> Scene Security Once the investigator has defined the area to be protected: • Various methods and levels of securing the area may apply. • Document what types of activities have occurred in that area prior to securing it. • Document the time the area was secured, how, and by whom.	05-14-FI210-EP
Note: Consider the need. Do you need to protect something bigger than your general origin area and/or is it more effective to restrict access to an area larger than the general origin area? Various methods of securing the area may apply – dependent on the scene the investigator may need to run barrier tape, position security personnel, or institute closures that restrict access.	

OUTLINE	AIDS & CUES
Note continued: Once the investigator, using fire patterns, the fire behavior, and witness statements, has determined a reasonable area that likely has within its boundaries the General Origin Area, the investigator should arrange for scene protection needs. Determine what types of fire suppression actions have already taken place within the area to be protected to determine what alteration or disturbance exists or what influence fire suppression actions had on fire progression and fire patterns. Document what method was used to protect the area. This can be done in both writing and by photographs.	
<u>Documentation - Field Notes:</u> General Origin Area documentation: • Fire behavior • Activities that have affected the area • The fire indicators • The witness statements • Methodology utilized to work the general origin area (e.g., entering from the advancing area, working between the lateral spread indicators…)	05-15-FI210-EP

OUTLINE	AIDS & CUES
Note: Documenting the fire behavior, burn indicators, and witness statements can often be accomplished by field notes supported by photographs. The metadata of photographs will show the time frame of the field work.	
<u>Documentation - Field Notes:</u> Specific Origin Area documentation: • Indicator categories identified • Representative fire pattern indicators • Any evidence located • Fire behavior • Fuel components, depth, and compactness • Barriers to fire spread	05-16-FI210-EP
Note: The investigator may be asked to give testimony concerning how they arrived at the general origin area, what macroscale and microscale indicators they depended upon to find the specific origin area, what evidence was found and where, and the fire behavior. The investigator should be able to articulate the process they used. Exemplar indicators – the representative indicators the investigator documented in detail. Some of the documentation in the SOA will be covered in the sketch and photo log which will be addressed in a later unit.	

OUTLINE	AIDS & CUES
Note continued: Include the measurements (size) of the specific origin area (as appropriate). Documentation - Field Notes: • Be able to articulate what you did, how you did it, and why you did it a particular way. • Field documentation is generally scene specific, depending on the circumstances. • There is no standard sequence for scene documentation. For example: work the general origin area and document it before moving on to the specific origin area vs. work the general origin area and the specific origin and then document both Note: There is no set sequence of when the general origin area is to be documented. Some investigators prefer to document (photo, measure, sketch, etc) the indicators as they find each one, some prefer to locate all the indicators then go back and systematically document the indicators. This second sequence allows for the selection of the best indicators once all the indicators have been identified. The first sequence should be considered if there are specific concerns about potential destruction of the indicator(s). The investigator may also want to take into consideration the angle of the sun when taking photographs of indicators and time the sequence of this photo documentation when the best sunlight is available.	05-17-FI210-EP

OUTLINE	AIDS & CUES
Field Notes: • Maintenance of field notes is an agency specific procedure. • Retention of notes may differ depending on the type of action being taken. • Check with and follow your agency protocols for retention of notes. Note: Your agency may have a procedure that notes are destroyed after they have been transferred to your final report. Investigator should be ready to answer questions about such practices and why it is consistent.	05-18-FI210-EP
Documentation – Interviews/Statements: • Notes • Written Statement (signed) • Recorded interviews • Memorandum of Interview • Supporting documents Note: Notes pertaining to an interview, along with any audio and video should be maintained per agency policy. Investigators may take a written statement created by the subject which can be combined with a Memorandum of Interview documented the investigator's recollection of the interview.	05-19-FI210-EP

OUTLINE	AIDS & CUES
Note continued: Any or all of the items referenced above become part of the investigative case file. **Interviews/Statements are covered in more detail in a separate unit of this course. Have individual read the statement to you and/or sign it stating that they can read.	
<u>Documentation – Sketches:</u> • Sketches are created in the field as part of scene documentation. • Diagrams (when needed) are created from the field sketches and other data • May be appropriate to create multiple sketches: – Photographs – Evidence – General origin area – Specific origin area – Fire progression	05-20-FI210-EP
Note: As appropriate, sketches may be the only "drawing" in your report, e.g., no diagrams. The sketches are used to enhance and illustrate your field notes to better refresh your memory when you prepare your final report and when and if you become involved in subsequent litigation or administrative processes.	

OUTLINE	AIDS & CUES
Note continued: Multiple sketches are appropriate and recommended. It can be difficult to capture all the data needed on one sketch without overcrowding the sketch. It is recommended to create separate sketches for your fire progression/burn indicator map, another for your photo points, another for the general origin area, and a separate sketch for the specific origin area. The complexity of the scene and investigation will influence the number of sketches you create in the field. Tell students they will be creating sketches in their field exercises.	
<u>Documentation – Sketches</u>: Sketching • Part of field note and follow-up office process. • Not to scale. • Represents general overview. Use to correlate to other documentation products such as: • Final narrative report • Field notes • Photos • Witness statements • Diagrams • Lab results	05-21-FI210-EP

OUTLINE	AIDS & CUES
Note: Consider using a scene sketch during witness interviews to help understand the witness's explanation of what was observed. The sketch used/created during the interview should be initialed, dated, and kept as an attachment to the statement. Correlating the sketch to the photographs will be discussed in greater detail "photography documentation."	
<u>Documentation – Sketches:</u> Sketching fire progression • Outline general origin area • Landmarks for orientation and to refresh memory • Map general fire progression using: – A blue "U" symbol for backing – A red arrow symbol for advancing – A yellow "V" symbol for lateral	05-22-FI210-EP
Note: Sketching should be done while at the scene, during the investigation, not back at the office. Symbols do not necessarily need to be in color on the sketch. The field sketch does not need to have a symbol at each indicator located. The symbols on a sketch map do not necessarily represent a specific indicator on the ground but rather portray a general progression of the fire spread.	

OUTLINE	AIDS & CUES
Explain you don't have to put a symbol on the map for every indicator you find on the ground. Ensure students include compass direction on the sketch and orient the sketch accordingly.	
<u>Documentation – Sketches:</u> Example	05-23-FI210-EP
Note: While creating a sketch map of the area and pertinent features, accumulation of the raw data that will make a more accurate map possible is just or more important. The investigator should systematically collect such data for use if a diagram is to be made in the future.	
<u>Documentation – Sketches:</u> Sketching fire progression Specific origin area • Indicate its location within the general origin area. • Recommend including boundary measurements of specific origin area. • Continue to show fire progression based on indicators (e.g., micro indicators). • Indicate the boundaries of the ignition area.	05-24-FI210-EP

OUTLINE	AIDS & CUES
Note: Suggest the general origin area sketch on a separate sheet from the specific origin sketch, also separate from the photo point sketch. Remind students of the definition of ignition area being the smallest location that an investigator can identify which includes a heat source and fuels first ignited. The ignition area symbol dimensions should reflect the approximate shape and size of the smallest location identified.	
<u>Documentation – Sketches:</u> Sketching fire progression • Photo points • Evidence locations • Reference points	05-25-FI210-EP
Note: Photo point symbols establish the positional relationship between the investigator taking the photo and item(s) being documented. Other sources of recommended symbols, NWCG, PMS-475 Basic Land Navigation, chapter 1, symbols; PMS-210, Wildland Fire Incident Management Field Guide, Chapter 4, pages 136-137.	
Refer to slide for example of symbols.	

OUTLINE	AIDS & CUES
<u>Documentation – Sketches:</u> Photo points • No standard addressing how many photos should be taken to document a scene. • Consider how photos are intended to be used. Note: Photography will be covered in greater detail later in this unit. Recommend a separate sketch documenting photo points to keeps sketches legible. Document indicators that are the best representative examples (lighting, perspective, clarity, etc.) which you can articulate to counsel, jury, etc. The amount and type of photographs is dependent upon the specifics of each fire and fire investigation. Investigators should conform with agency policy in using photo documentation while considering the potential of long term litigation or administrative actions. Most in camera GPS units are not precise enough for use within the general or specific origin area and measurements or other more precise positioning techniques are recommended.	05-26-FI210-EP
<u>Documentation – Sketches:</u> Example	05-27-FI210-EP

OUTLINE	AIDS & CUES
Documentation – Sketches: Evidence • Both inside and outside general origin area. • Document relevant items, not just what you think started the fire. • Ensure proper evidence handling. Note: Depending on number of evidence items you may need a separate sketch for evidence. Shooting range fires, roadside fires are examples of areas where multiple evidence items are likely present. Ensure proper evidence handling: chain of custody, disturbance, documentation, preservation, and collection.	05-28-FI210-EP
Documentation – Sketches: Field Measurements • Reference points – Likely included on previous sketches, not a stand-alone sketch. – Consider indicating on the sketch which measurement method utilized. Note: Reference points should be documented on the sketch(es). They are used in correlation to field measurements to show relationships between items on the scene. They may also be used to recreate the scene at a later date.	05-29-FI210-EP

OUTLINE	AIDS & CUES
<u>Documentation – Sketches:</u> • Measurement Techniques – Right angle transect – Azimuth – Intersecting arcs (Triangulation) Note: The technique the investigator uses will likely be case specific, dependent on slope, vegetation, obstacles.	05-30-FI210-EP
<u>Documentation – Sketches:</u> Right Angle Transect • Mark reference points on ground with locatable marker (e.g., nail, rebar, paint-mark). • Recommend use of N/S and E/W bearings. • Utilize the units shown on your measuring tape (e.g., feet/inches, meters/centimeters). Do not estimate smaller dimensions. • Use a steel tape. • Can use multiple reference points. Note: Advise students to use the measuring marks on the tape being used and do not estimate 1/16” if the tape only shows down to ¼”. Use the marks on the tape being used.	05-31-FI210-EP
<u>Right Angle Transect:</u> Example	05-32-FI210-EP

OUTLINE	AIDS & CUES
Note: A measurement log may be used. The following information would need to be portrayed for the above example. **Indicator 12 Right Angle Transect RP-1 18' 4" W /10' 6" S.** Using a measurement log may take the place of having to place each indicator or item of evidence on the sketch map. Using the measurement log technique, the investigator will have all of the necessary data to create a diagram showing indicators or other pertinent points as long as the reference points can be accurately located.	
<u>Documentation – Sketches:</u> Azimuth Useful for short distance measurements at a scene that does not have many obstacles. • Mark reference points on ground with locatable marker (e.g., nail, rebar, paint). • Record compass declination used. • Utilize the units shown on your measuring tape (e.g., feet/inches, meters/centimeters). • May be difficult on steep ground and in heavy brush or timber.	05-33-FI210-EP
Note: Compass declination – you can set your compass to the scene declination or to zero declination, just record in your field notes the declination your compass was set to.	

OUTLINE	AIDS & CUES
Note: Measurement detail should be to the increment of your tape measure. If your tape is divided only to ¼ inch marks, measure to the nearest ¼ inch (not smaller to the 1/8 inch).	
Azimuth: Example	05-34-FI210-EP
Documentation – Sketches:	05-35-FI210-EP
Intersecting Arcs (Triangulation) • Mark reference points on ground with locatable marker (e.g., nail, rebar, paint-mark). • Utilize the units shown on your measuring tape (e.g., feet/inches, meters/centimeters) and reference to a general compass bearing. • May be difficult on steep ground and in heavy brush or timber. • Recommend use of N/S and E/W bearings.	
Intersecting Arcs (Triangulation): Example	05-36-FI210-EP
Documentation – Diagrams:	05-37-FI210-EP
May contain some or all components of the sketch: • Final diagram is to "near" scale. • Contains a legend. • Can be hand drafted or computer generated. • Guidance and examples are in the student handouts.	

OUTLINE	AIDS & CUES
• Agency/Investigator decision to create one.	
Note: Explain that separate diagrams should be created as necessary, such as one for fire progression, one for photo points, one for evidence (if numerous evidence objects). Explain to students to mark the final diagram stating it is to near or approximate scale. Not every fire investigation requires a formal diagram(s). It is up to the agency and/or the investigator to determine if and when a diagram is created.	
<u>Documentation – Diagrams:</u> Example Note: Diagrams can be created using software available to the investigator or may be created by experts in the area of surveying and mapping. The investigator should be aware of the diagraming resources available to them and the appropriate resource request process. It is suggested that the representative fire pattern indicators (those documented by photographs and measurements) located within the diagramed area be accurately plotted and direction of fire spread symbols used to establish actual rather than approximate fire direction spread.	05-38-FI210-EP
<u>Documentation:</u> GPS • Consider using GPS to record key data points. • Be sure to note datum setting and rate of error in your notes and reports.	05-39-FI210-EP

OUTLINE	AIDS & CUES
• Some GPS units will take geo-tagged photos. • Consider contacting your agency GIS staff to generate map products for your reports.	
<u>Documentation:</u> GPS	05-40-FI210-EP
• Specific Origin Area: Hand held GPS units with error rate of more than + or - 1' are generally not recommended. • General Origin Area: Hand held GPS units with error rate of more than + or – 5' are generally not recommended. • General Fire Area: The use of hand held GPS units in the area outside the general origin area, to position macroscale indicators etc., may be an effective tool for plotting those features.	
Note: The use of hand held GPS units (those with error rates of + or – 5' or more is generally not accurate enough in the smaller areas of the General Origin Area and the Specific Origin Area. Based on the specific conditions and need for accurate plotting of key features, the investigator may use a hand held GPS unit within these areas. In that case, it is recommended that the GPS readings be backed up with measurements to points for validation and orientation. Hand held GPS units with accuracies of less than + or – 5' may be available through agency or contract resources. The GPS area calculation function may be helpful in determining the size of the area that investigator walked to determine the general origin area.	

OUTLINE	AIDS & CUES
Note: Exception: The use of a reasonably accurate hand held GPS unit (+ or – 20') for taking coordinates for photo points is generally appropriate for helping someone to go back to the same location using both the GPS reading and the photo to compare to on the ground and for photo diagram preparation. In this case, the photo diagram legend or attached spreadsheet should provide such information on how accurate the coordinates are, including the possible deviation for each photo. (Example: Photo AWC1056, N45 168.124, W170 152.344 + or – 9', etc.)	
<u>Documentation – Photography:</u>	05-41-FI210-EP
Recommendations • Consider formatting the SD card before beginning investigation photos. • Confirm the correct date and time on the camera(s) used. • Check the picture format (jpeg, RAW, etc.) • Downloading the photos is discussed later in the evidence handling section. • This is not meant to be a photography class, you will need to understand the limitations of your photography equipment.	
Note: Format the SD card – eliminates possibility of unrelated photos on card, causes the first photo to be "0001" rather than 0023 etc.	

OUTLINE	AIDS & CUES
Note: Consider adding your initials to the photo number to reduce the confusion of multiple investigators taking photographs starting with the photo number of 0001. This typically can be done as a batch process during downloading of images. Example "0001" would become "AWC0001." Using this systematically will facilitate explaining how the photos were tracked during later testimony. The lead investigator should make it clear to assisting resources what systematic numbering system is expected. Picture format – jpeg, RAW for picture quality, file size, ability to enlarge and show sufficient detail, sufficient cards on hand to document what's needed. Consider documenting that you confirmed the correct date and time on the cameras. Check the dates and times of other team member cameras used.	
<u>Documentation – Photography:</u> Start a photo log. • Examples of photo logs are in the student handout. • Use an image (photo) numbering system you can understand when you download the images later. – May use image number.	05-42-FI210-EP

OUTLINE	AIDS & CUES
• Include a description of each photo in your log. – Can be brief in your notes, more detailed on final log. • Photo number is documented on sketch with photo points.	
Note: Consider tying your photo log number to your metadata image number for consistency and simplicity. Use a numbering system you can understand when you down load the images.	
<u>Documentation – Photography:</u> Storing Digital Photos to CD/DVD • Be aware of "Auto-load" software effects on the image files. • Do not open or delete original photo files. • If possible, copy files directly from camera card to CD/DVD. – Mark and secure 1st downloaded copy. – When appropriate, store a 2nd copy as your backup. – Copy a set of working files to PC hard drive.	05-43-FI210-EP

OUTLINE	AIDS & CUES
Note: Secure an untouched image file on a CD/DVD. This can be done by copying and pasting the entire image folder from the camera card directly to the CD/DVD without opening any specific file/image. Then a second working copy can be created and used during the investigation. Do not delete any photo files taken during the investigation, even if they are of poor quality. Work off copy on your hard drive.	
<u>Documentation – Photography:</u> Marking Photo CD/DVDs • Permanent marker • Write in spindle area • Labeling – Case/incident number – Date photos taken – Brief identifier or fire name – Name of photographer	05-44-FI210-EP
Note: Be careful about writing on the silver or gold face of a CD or DVD, even with markers that are supposed to be safe for CD/DVDs. Eventually the dyes and chemicals from the marker will deteriorate the coating and corrupt the data on the disk.	

OUTLINE	AIDS & CUES
Documentation – Photography: Fire Direction – Photo log components • Incident identifying information • Camera used and time stamp corrections • Photo identification number • Date photo taken • View direction (N, NW, ENE, etc.) • Person taking the photo Note: Incident identifying information may include the incident number, incident name, location, etc. Camera used should include the brand and model along with confirmation it is digital. If the time stamp on the photos or metadata attached to the photos is off for any reason, attach an explanation of why and by how much, i.e., all photo times are "Pacific Standard Time" and should be adjusted by one hour later for the "Mountain Standard Time" zone in which the photos were taken; or, camera recorded time was 10 minutes off. All time stamp data should have ten minutes added to the time recorded. The photo identification number should be unique and not repeated during the same investigation. To accomplish this, a specific identifier may be added to the camera photo number when saving to avoid two separate investigators having the same numbered photos. The use of the initials of the photographer may be helpful in separating out photos, i.e., AWC1026, as opposed to GLW1026.	05-45-FI210-EP

OUTLINE	AIDS & CUES
Note continued: The photo date taken can be placed for each photo or used once for a group of photos, i.e., Photos AWC1026-AWC1099 were taken on August 8, 2011. The view direction is the direction in which the camera is pointed at the time of the photo. Normally general directions are used. The person taking the photos should be identified and should sign the photo log.	
<u>Documentation – Photography:</u> Fire Direction – Photo log (cont.) • Vector (advancing, lateral, backing) • Category of Indicator (Staining, angle of char, protection, etc.) • Direction of fire travel in the photograph • Photo point coordinates • General description	05-46-FI210-EP
Note: The vector is identified as either advancing, lateral, or backing. If more than one vector is present in a photo, explain. Fire pattern indicators photographed should be identified with the category of indicator. The direction that the fire is traveling in the photograph will help others to understand the progression of the fire by the photographs. For example, the fire is moving left to right in photo. Or, fire is moving from lower right corner to upper left corner in photo.	

OUTLINE	AIDS & CUES
Photo point coordinates are needed if a reasonably reliable point diagram is to be created. With rare exception, these coordinates need not be precise and the use of a GPS device with accuracy of less than + or – 20' may be acceptable. This may need to be reconsidered as the photo points get closer together, such as near the specific origin area. The general description of what is shown by the photo will assist the investigator, sometimes years later, to recall why the photo was taken and what was being portrayed. Be as complete as possible. If multiple photos in series have the same subject matter, repetitive photos can be described by referring to the description in the first photo of the series, i.e., same as photo AWC1056, etc.	
<u>Field Notebook Photo Log:</u> Example	05-47-FI210-EP
Note: Consider tying your photo log number to your metadata image number for consistency and simplicity. Use a numbering system you can understand when you download the images.	
<u>Documentation – Photography:</u>	05-48-FI210-EP
Investigative Photographic Documentation: • Enroute • Arrival • Scene Orientation/Overview • Relationship	

OUTLINE	AIDS & CUES
• Identification • Examination • Other Considerations, (e.g. witness perspective) We will now discuss in detail each of these categories. Note: The demands of each individual fire scene will dictate to some extent when photographs can be taken. The important thing to remember is that some opportunities may be lost while others can be put off until later. Prioritizing and staffing is the responsibility of the investigator. <u>Documentation – Photography:</u> Enroute photos • Smoke column • Fire progression • Condition of access Note: Enroute photographs: Investigators should consider the need to take photos while enroute, this may be dependent on the time of response and purpose of the photograph. For example, if the investigator is responding promptly the "enroute" photos may show fire progression, evidence, condition of access (open or closed gates), and activity in the area.	05-49-FI210-EP

OUTLINE	AIDS & CUES
<u>Documentation – Photography:</u> Arrival photos Documents scene before it changes. • Persons present • Condition of evidence (e.g., power line) • Macro Indicators • Landmarks Note: Arrival photos - persons and man made things in the area of the fire scene are generally mobile in nature. Power line equipment can be burned up or removed by power company crews. Heavy equipment can be moved to other sites or parts removed from them. Witnesses may walk or drive away. Photos may assist the investigator in quickly documenting the presence of certain persons and things during a period when time is short and workload is heavy. Identifying the presence of equipment, persons, and actions during the first arrival on scene is part of the data collection process that will be used later to develop hypothesis. Upon the arrival of the investigator, he/she may want to document current fire behavior, both near the heel of the fire and overall. It may be a good idea to take on scene weather readings.	05-50-FI210-EP

OUTLINE	AIDS & CUES
Documentation – Photography: Scene Orientation/Overview Photos • Show integrity and relationship of scene to overall environment. • Taken from a distance • Displays the overall relationship between physical evidence or burn pattern indicators and the scene. Note: Orientation and overview photographs serve as big picture documentation of the scene or other points of interest. These overview photographs can also be used at a later time for testimony either unchanged or with explanatory symbols.	05-51-FI210-EP
Overview of General Origin Area: • Photograph prior to entering. • Multiple perspectives and focal length. Note: When the general origin area has been identified, photo document the area immediately surrounding it and the general origin area itself. This process may be incorporated into the walk around and may include multiple views of the entire surrounding area and views into the general origin area from the perimeter. This will also serve to document the date and time of the walk around through the camera metadata.	05-52-FI210-EP

OUTLINE	AIDS & CUES
Note continued: The investigator should attempt to cover the area with photographs so that multiple perspectives of most areas can be reviewed to compare opposite sides of larger objects.	
<u>Photograph comparison fuels:</u>	05-53-FI210-EP
Note: The investigator should photo document fuels both in the burn and outside. If possible, get photos which portray both the burned and unburned fuels in a single photograph. Taking photos of actively burning areas which are representative of the general origin area is also helpful. Remember, you are trying to document a representation of the fuels in the specific origin, general origin area, and the heel of the fire. This may require multiple photographs and some analysis to do properly. If the general origin area is well within the burned area, photos of representative fuels may be taken at a distant location which has similar vegetation type, vegetation density, aspect, and slope.	
<u>Documentation – Photography:</u> Relationship photos • Shows the relationship between various items • Taken at medium range • Shows specific views of subject matter • Begins to focus on specific portions of the area or scene	05-54-FI210-EP
<u>Documentation – Photography:</u> Relationship photos	05-55-FI210-EP

OUTLINE	AIDS & CUES
Note: As the investigator is working the scene, he/she should take relational photographs to document features and activities that are near to the general origin area. This can include the location of highways, railroads, trails, dirt roads, skid trails, structures, lookouts, etc. A single photo which shows the train tracks/train and the fire near the tracks would be preferable to two photos such as in this slide which show each of them.	
<u>Documentation – Photography;</u> Relationship photos • Consider using evidence markers to show locations of evidence.	05-56-FI210-EP
Note: Evidence markers provide better visibility of smaller items when taking orientation photos of the area. Further detailed close-ups should follow. Take a photo both without and then with evidence markers. Be careful that the evidence markers are correctly documented with the feature being portrayed and the marker does not disturb or put shadow on the item being photographed.	
<u>Documentation – Photography:</u> Identification Photos • Shows detail of a specific item of evidence or an indicator. • Taken close up. • Shows detail of subject matter.	05-57-FI210-EP

OUTLINE	AIDS & CUES
Note: May include fire progression/burn indicators, tire or shoe impressions, sources of ignition, other evidence such as controls and samples.	
<u>Documentation – Photography:</u> Identification Photos Written and photographic documentation of sample, comparison samples, and exemplar collection and retention: • Rock • Metal • Insulators • Soil • Fuel	05-58-FI210-EP
Note: Explain the concept of control and sample collection. Sample: A portion of an item which is suspected of being contaminated with an additional substance, (typically an ignitable liquid) which has been collected for testing in an effort to identify its component parts and any contaminating substances. Comparison Sample: (Sometimes referred to as control samples) A sample becomes a comparison sample when taken from the same type of material that it will be compared to and is recovered from an area where the investigator believes there is no contamination relevant to the testing, and testing shows no relevant contamination, only its base components.	

OUTLINE	AIDS & CUES
Note continued: Exemplar: When dealing with items such as rocks, fuel, or other items needed to compare to a sample taken from a scene, those items are referred to as exemplar comparison samples and should be taken from as near the same location as the sample being tested against for which the investigator does not suspect relevant contamination. Effort should be made to make the exemplar sample consistent with the specific sample or area to be compared. In a fire investigative context, a sample is an amount of any substance, typically recovered from the scene, which is submitted for testing to determine its components. A control sample, also known as a check sample, is an item of known composition used to check the samples themselves. This often requires that the actual control sample itself be tested to determine its components. The components of the control sample are then compared to the samples taken from known locations or items of evidence.	
<u>Documentation – Photography:</u> Identification Photos • The general origin area may contain thousands of indicators. • Mark/flag enough to establish overall fire progression and origin. • Document representative sample of those that you mark/flag. – No minimum or maximum number.	05-59-FI210-EP

OUTLINE	AIDS & CUES
– Enough to show the methodology relied on. – Illustrate the scene at a later date. Note: As with any area of the fire, potential directional burn indicators within the general origin area may number into the thousands. The job of the investigator is to identify and document enough of these indicators to provide for reliable and consistent vector data which establishes the progression of the fire. While the investigator may observe many indicators within a small area, selection of the best of these indicators for documentation through flagging/marking will include a selection based on variety of indicator types, reliability of indicator within the given conditions, and consistency. Subtle indicators, while more difficult to photo document, should be included. These subtle indicators may support lower intensity burning consistent with areas closer to the specific origin area. <u>Documentation – Photography:</u> Identification Photos • Document more than one indicator of multiple indicator categories – don't rely on just one. • It is better to over document the indicators rather than under document them.	05-60-FI210-EP

OUTLINE	AIDS & CUES
Note: The student should be told that ultimately the indicators will need to be documented in such a way that a qualified individual will be able to review the report, observe enough of the indicators documented, and be able to see that the investigator was appropriately interpreting each indicator. While there will always be times when indicators are very subtle and need an expert to explain them, most of the indicators documented should be easily identified once the investigator has documented them and explained them. Documentation of enough indicators in an area to show the overall pattern of the fire spread, including the advancing, lateral, and backing fire spread, will not only support the work that was done by the investigator(s) in the field, but will assist in providing an accurate sketch or diagram.	
<u>Documentation – Photography:</u> Identification Photos Fire progression • Color-coded flags can be used to demonstrate overall fire progression. • Directional interpretation of an individual indicator. • Advancing, lateral or backing. Note: There are a number of ways investigators have shown vector direction in their photographs. This course suggests the use of colored pin flags, a method which is designed to provide an educated and trained reader of the report with graphic information documenting the progression of the fire.	05-61-FI210-EP

OUTLINE	AIDS & CUES
<u>Documentation – Photography:</u> Identification Photos	05-62-FI210-EP
Vector Documentation	
Options for documenting fire progression of individual indicators:	
• Memory/good photos	
• Old school	
• Flags only	
• Fire direction arrows	
• Vector symbols	
• Use the recommended symbols/colors.	
Regardless of how you do it, be consistent.	
Note: Photographs of burn indicators showing fire progression are enhanced through the use of visual aids including flags and vector symbols. The investigator may use those props which help to demonstrate the content of the photo without contamination of the indicator itself. No matter which props are used, be consistent and explain your method and/or meaning in your report or attachments.	
<u>Sometimes a single photograph is enough!</u>	05-63-FI210-EP
• Consider indicator reliability before photographing.	

OUTLINE	AIDS & CUES
Note: Identification photos show the detail of a specific item of evidence or an indicator. Taken close up. Shows detail of subject matter. Documents such things as tire or shoe impressions sources of ignition and other evidence. When taking identification photos, chose reliable indicators to document. This small gourd shown in the photo could have rolled prior to this photo being taken. However, the burn pattern on it is consistent with the protection of fuels behind it and thus suggests that it has not rolled and may be used as a reliable indicator.	
Sometimes it takes two views, or more…:	05-64-FI210-EP
Note: Some indicators will take two or more views to properly document photographically. Any indicator which is based on "compare and contrast" of burn damage should be considered for multiple views and focal length. Exceptions to this rule may be small objects which are lying in such a position that two sides can clearly be documented with one overhead photograph. Any other time, multiple views, contrasting, may need to be taken.	
Documentation – Photography: Examination Photos • Photographs taken close-up, with a scale designed for evidence photography.	05-65-FI210-EP

OUTLINE	AIDS & CUES
• Scaling – May help with examination if a positive examination is made later. – Is not always necessary but is recommended. – Consider using special lenses and/or lighting techniques.	
Note: When done correctly, examination photographs will assist the investigator by providing details images of items that many times are packaged and stored in an evidence facility. The ability to examine good quality images may prevent the need for opening evidence packages, documentation of chain of custody, and repackaging.	
<u>Documentation – Photography:</u> Examination Photos • Photo details of evidence in secure location. • With and without scale • Identify evidence item in photo.	05-66-FI210-EP
Note: Examination photographs are taken close-up, preferably with a scale that is designed to establish the size of evidence. Is not always necessary, but is recommended. Consider using special lenses and/or lighting techniques. May be done both at scene and in a safe environment later.	

OUTLINE	AIDS & CUES
Note continued: After taking photographs of evidence in place, the evidence should be collected, packaged, marked, and secured. Due to the risk of contamination and or loss of the evidence, further detailed photographic documentation and measurement of these evidence items should be saved for a safe environment. Comparison photographs, such as that shown in this slide, may be taken, but care should be exercised to avoid cross contamination of the evidence or mixing of different evidence items.	
<u>Consider photo documenting some measurements:</u>	05-67-FI210-EP
Note: It may be useful to photograph key distances as they are being measured. This will assist in putting those measurements into perspective and will also assist in refreshing the memory of the investigators during later testimony. Example: Evidence item #1 was located 11" off the edge of the pavement.	
<u>Documentation – Photography:</u>	05-68-FI210-EP
Note: Often, ignition evidence is fragile and subject to decay when moved or unpacked. Consider taking extra photographs of ignition evidence to make sure that all features are visible in photographs and the need to remove the evidence from storage is reduced. Consider having blue background paper for high contrast photographs of ignition evidence or other important items.	

OUTLINE	AIDS & CUES
<u>Documentation – Photography:</u> Other Considerations • Specific origin area boundary • Planning for photo exhibits • Storing Digital photos to CD/DVD/Flash Drive • Marking photo evidence Note: The investigator will often be asked to describe the Ignition Area, Specific Origin Area, or General Origin Area boundaries. The simple use of flagging or other reference material can enhance photographs of such boundaries and save a lot of time during testimony. When taking photographs, think long-term needs. Such as, what photographs could I use during my testimony to better explain the investigation? Thinking about this ahead of time allows for deliberate photos for such use rather than settling for a photo taken for another purpose that may not completely serve your needs.	05-69-FI210-EP
<u>Consider flagging and photographing Specific Origin Area boundary:</u> Note: Consider flagging the boundary of the specific origin area to provide a graphic indicator. This may be done during the walk around of the specific origin area or may be done later. Scene protection and scene security should be considered when determining the appropriate time to flag the boundary of the specific origin area. The visual graphic of the flagging boundary provides an additional dimension to photo documenting the scene.	05-70-FI210-EP

OUTLINE	AIDS & CUES
Documentation – Photography: Photo Exhibits • Plan ahead for possible exhibits by taking photographs which document your investigation. • Document and photograph damages and values at risk. Note: Photo exhibits can play an important part in the documentation and presentation of the fire investigation. There is a wide range of subjects which can be documented through photo exhibits. Typically, the best time to take photographs for use as exhibits is when the scene is fresh. Larger scale photographs and aerial photos should be taken as soon as someone is available to take them. Aerial photos may be taken to document both the larger scale origin scene and fire damages and threats to homes or other property. The following slides will discuss some types of exhibits.	05-71-FI210-EP
Photo Exhibits – Fire Patterns: Recommend Noting: • Direction photo taken • Indicator category	05-72-FI210-EP

OUTLINE	AIDS & CUES
• Vector (advancing, lateral or backing) • Fire direction in photo • Location photo is taken	
Note: There are additional aids available on the market or that can be made at home which can help to present the message in each photograph. Many of these aids assist in the photo documenting of fire pattern indicators and can provide information such as: direction of advancing/lateral/backing fire spread, the orientation of north is each photo, the fire pattern indicator evidence reference number.	
• Photo document special features such as spot fires. • Photo document values at risk.	05-73-FI210-EP
Note: These photos can support the serious nature of the fire and may be used both in the judicial system and in the administrative roll of fire prevention presentations. These photos may come from the investigators themselves or may be collected from others who have taken photographs of the area.	
<u>Orientation photographs:</u> • Aerial perspective • Ground perspective • Take photos from multiple perspectives and focal lengths.	05-74-FI210-EP

OUTLINE	AIDS & CUES
Note: Orientation photographs taken from the air and/or ground can provide foundational views of the area around and including the General Origin Area. These photos help to show the relationship of larger features to the General Origin Area. They can also serve as the background to graphically explain fire progression and suppression activities as shown in the following slides. It is important to get multiple perspectives to show as many angles as needed to document such items as macroscale indicators, feature locations, and other pertinent items. Changing focal length allows for larger scale, medium scale, and closer in views of the area.	
<u>Fire Origin and Progression :</u>	05-75-FI210-EP
Note: Orientation photos, such as the one in this slide, can be used in series to show the progression of the fire on a larger scale than just the General Origin Area. This is one technique available through the use of digital photography which will allow a graphic portrayal of the fire progression along with the effects of fire suppression actions. Exhibits such as this may be used to educate attorneys, judges, and juries, along with documenting a hypothesis for review and testing by other investigators.	

OUTLINE	AIDS & CUES
Fire Origin and Progression :	05-76-FI210-EP
Note: These types of photo exhibits can aid the investigator during testimony by showing graphically the relationship of fire suppression actions (retardant drops, control lines etc.) and the advancing, lateral, and backing spread of the fire. They can further be used to show search patterns used in the general fire area to follow advancing fire patterns back to the origin.	
Fire Origin and Progression :	05-77-FI210-EP
Note: In the case of witness testimony concerning early observation of the fire, it may be useful to take a photo from the position that the witness was located and then identify in the photo key features pertaining to the witness statement. Example: "I was standing on this road (where the photo was taken from) and I initially saw smoke coming from the group of trees I am pointing at." (circled as the Specific Origin Area)	
Documentation – Report:	05-78-FI210-EP
INVF role versus Case Agent/Case Manager (INTM) role: • This is agency dependent. • May change by incident. • Make sure you are clear about your responsibility for each assignment. • Your role may change over time.	

OUTLINE	AIDS & CUES
• INVF is the first line of investigation Ask questions if you are not sure! Note: As the INVF your job may only be the issues directly related to the origin and cause of the fire. This may be focused primarily on reading and following burn indicators, documenting the scene, on scene interviews, weather data, and photographs. You will gather and document this data and provide it to the case agent/case manager. You as the INVF will prepare an "origin and cause" report containing this data, that often becomes the lynch pin to the final fire investigation report. Some agencies may have case agent/case managers that are not INVF qualified or experienced in fire investigation however those case agents will be handling the criminal or civil case investigation. The O&C report that the INVF produces will become part of the agent's final case report and the INVF will likely be more involved with the case agent/case manager to educate them on fire investigation issues. Whereas, those of you that are the INVF as well as the Case Agent/Case Manager will perform the issues related directly to the origin as cause as listed above AND continue with all the other tasks need to complete the overall criminal and/or civil case investigation.	

OUTLINE	AIDS & CUES
Documentation – Report: Investigative/Case File consisting of electronic and/or hard copies may include: • Origin and Cause report(s) • Reports of Interview • Sketches/diagrams/measurements • Maps • Weather data • Miscellaneous reports and documents (e.g., forensic, expert, other agency) Note: Regardless of your role you will have an investigative case file, the contents and extent of the file will be role dependent. The file may include, but is not limited to, any or all of the items listed on this slide. Sketches are also a part of the case file and are normally part of the attachments to the report. Diagrams may or may not be included in the case file. In the field investigative process data has been collected to provide a diagram later in the process, if so needed. All photos should be included in the case file. Evidence logs should be up to date at the time of inclusion into the case file/report.	05-79-FI210-EP

OUTLINE	AIDS & CUES
Notes continued: Investigative notes should be included into the report/case file per agency policy. Correspondence, including emails, should be retained per agency policy and included into the case file for later discovery. Supporting documents which assist in the understanding of the investigation, origin location, cause, or other important facts of the case should be attached to the case file by reference.	
<u>Documentation – Report:</u> Investigative/Case File consists of: (cont.) • Photographs/Photo logs • Evidence Log • Investigative Notes (per agency policy) • Correspondence (e.g., emails, texts) • Supporting exhibits	05-80-FI210-EP
Note: Investigative notes should be included into the report/case file per agency policy. Correspondence, including emails, should be retained per agency policy and maintained for later discovery. Supporting documents which assist in the understanding of the investigation, origin location, cause, or other important facts of the case may be attached to the case file by reference.	

OUTLINE	AIDS & CUES
Documentation – Report: Origin and Cause Report • Format is agency or prosecutor specific (examples in appendix) • Basis for INVF testimony • Becomes an attachment to final case report Consider adding a disclaimer: "I reserve the right to change my opinion or conclusions based on any additional data received."	05-81-FI210-EP
Documentation – Report: Origin and Cause Report (cont.) • Narrative Format • Chronological order of incident • Tell the story from start to finish in the order in which the fire events occurred. – What was the fire behavior context? – What fire pattern indicators were relied upon? – What evidence of the cause was located and collected? Note: The narrative section of the report/case file should follow agency policy. Most are completed in a chronological format.	05-82-FI210-EP

OUTLINE	AIDS & CUES
Documentation – Report: Origin and Cause Report (cont.) Narrative section explains: • Facts from witnesses and other sources. • How data was used to develop hypothesis. • How hypothesis was tested and final hypothesis was selected. • Conclusions. • Attachments and supporting documents/photos. Note: What evidence of potential causes was found and how they were evaluated for development of hypothesis. The investigator is documenting in the narrative report the basis for his/her expressed opinions. By the time the reader gets to the end of the narrative, he/she should have a good foundation of what the opinions expressed are based on.	05-83-FI210-EP
Documentation – Report: Origin and Cause Report - Narrative 1. Call and Response 2. Arrival on Scene 3. Methodology/Data Collection 4. Data Analysis and Application	05-84-FI210-EP

OUTLINE	AIDS & CUES
5. Working Hypotheses Development 6. Hypotheses testing 7. Conclusion/Selection of Final Hypothesis	
Note: This is the section of the report where the INVF articulates the methods used within the framework of the scientific method resulting in the overall "Methodology" applied for the specific conditions of the specific investigation. Scientific Method framework + methods applied = Methodology Investigators are cautioned against using cut and paste language within their report which detracts from the uniqueness of each fire investigation and report.	
<u>Documentation – Report:</u>	05-85-FI210-EP
Origin and Cause Report Call and Response: • Time of call, time of response, who requested you, information/data gained • Assignment/instructions	
Example: At 2:35 PM I was contacted by the Wildfire Dispatch center and assigned to investigate the origin and cause of the North Fork fire. I responded from my office at 2:47 PM. I traveled to the fire scene by way of … The dispatch center provided me with the following information… I observed the following enroute…	

OUTLINE	AIDS & CUES
Note: This section of the narrative report serves to introduce the reader to how and when the investigator became involved in the specific fire investigation and the responsibility and authority of the investigator. It also provides initial information about the fire received during the dispatch and/or response which can include the size of the fire, location of the fire, other resources being assigned, initial reports from the reporting party and first arriving responders, etc.	
<u>Documentation – Report:</u> Origin and Cause Report Arrival at Scene: • Describe the scene on your arrival – Time of arrival and location – Location and perimeter of fire – Surrounding area – Activities taking place – Observed fire behavior – Security in place (or not) – Witnesses, reporting party present – Data collected (Weather, statements etc.)	05-86-FI210-EP

OUTLINE	AIDS & CUES
Note: Writing the narrative report in a chronological format leads to the documentation next of the "Arrival at Scene:" (Corresponds to Define the Problem). Defining the problem more specifically allows for the construction of a more specific investigative plan and thus more organized efforts at data collection leading to a more complete narrative report. Once the investigator has arrived at the fire scene more data becomes available upon which an investigative plan can be further established. It is recommended that this data be documented in the narrative report in the chronological order it occurs. At this point the investigative plan will develop from a simple, "I need to determine the origin and cause of the North Fork fire as assigned" to a more specific plan which will start to identify specific tasks that need to be done with priorities as reflected in the due date/time of accomplishing each task. These tasks will generate more data which should be documented for the report in field notes and then transferred to the narrative section of the report. This process of developing an investigative plan and the tasks which are accomplished through it will provide the data which will allow the investigator to compose a complete narrative report. Poor narrative reports are often the result of poor planning and data collection.	
Documentation – Report: Origin and Cause Report Methodology/Data Collection: • Witness statements and interviews	05-87-FI210-EP

OUTLINE	AIDS & CUES

- – Suppression personnel; Reporting party; Civilian witnesses

- Fire behavior context
- General Origin - Describe your actions in detail
- Specific Origin - Describe your actions in detail
- Ignition Area – Potential ignition sources
- Documentation – Evidence, sketches & photographs
- Other observations and sources of information
  - – Weather, lightning data, 911 call logs, etc.

Note: Once an investigative plan has been developed, it will lead to the accomplishment of the tasks, creating data. Both the process (Methodology) for carrying out the tasks and the data collected should be documented in the narrative report chronologically as it occurs.

Because witness observations and the fire behavior context are often key components to establishing the General Origin Area, data collected during initial witness interviews and a description of the fire behavior context as observed by the investigator will often be the next items to be documented in the narrative report.

OUTLINE	AIDS & CUES

Note continued:
Example: "After my arrival I meet with John Jones at the intersection of Forest Road and Sunshine Ridge Road. Jones told me that he saw the smoke at about 1:30 PM when it was still about a quarter acre in size and he pointed the location out to me. Jones did not see anyone around and had no further information. I took photographs AWC0001 and AWC0002 from the location where Jones said he was when he saw the smoke, showing the view of the area where he said the initial smoke was coming from. I determined that the heel of the fire was burning on a southwest aspect with an approximate 30% average slope. The fire was burning in a northern direction with a wind out of the southwest at about 5 mph. at chest height.

Fuels included a canopy of mature long needle pine trees, incense cedar, and white fir. Ground fuels included light logging slash with annual grasses, pine needles, duff, punky wood, and sparse low brush."

Once any initial witness information has been gathered, and the fire behavior context is understood and described in the report, the reader of the report is prepared for the description of how the investigator found and determined the General Origin Area. Typically the logical progression of narrative report documentation will include the establishment of an advancing area, identification of lateral transition zones, and the subsequent reading of macroscale indicators. Written documentation of macroscale indicators can be linked to photo documentation in the narrative, helping the reader to visualize the actual items themselves as the narrative unfolds.

OUTLINE	AIDS & CUES

Note continued:
Once the methodology and data associated with determining the General Origin Area are documented in the narrative report, the same process generally can be repeated in documenting the Specific Origin Area and Ignition Area.

An area of the narrative report should describe the methodology used and data collected in searching the Specific Origin Area and the Ignition Area. Describing both in the narrative report in reasonable detail so that the reader may understand what took place and what was found.

During the search for the General Origin Area, Specific Origin Area, and Ignition Area, the investigator may be provided with an opportunity to gather additional witness information or other data which may decay over time. There is nothing wrong with putting the search for the Ignition Area on hold while such additional data is gathered.

Such information may include data which will assist in the location of the Ignition Area, or shed light on potential activities and causes in the area. If the investigator needed to leave the scene for any reason, the report should reflect the time period of absence along with an explanation as to how the scene was secured in their absence.

OUTLINE	AIDS & CUES
Documentation – Report:	05-88-FI210-EP

Origin and Cause Report

Data Analysis and Application:

At this point in the narrative report, most if not all of the pertinent data has been documented and the process of analysis has begun.

- Document why certain data was rejected.
- Document why certain data was relied upon.
- Describe the meaning applied to the data during the analysis process.

Note: Once all the methodology and pertinent data has been listed in the narrative report as it was chronologically collected, the investigator should now describe the process and result of data analysis. This will include the validating of data as reliable; not rumor, conjecture, or speculation, and providing meaning to the data.

During this step of the report writing it may be important to document why certain data was rejected and why other data was determined to be pertinent and reliable.

OUTLINE	AIDS & CUES
Note continued: The narrative report may document at this point the meaning applied to the data. For example, data indicating a wind out of the northwest at 5 mph. and a slope aspect facing southwest would indicate that both the wind and slope combined to influence the spread of the fire. Another example may include a marcoscale "U" fire pattern indicator which when analyzed indicated a general fire spread from the northwest to the southeast.	
<u>Documentation – Report:</u>	05-89-FI210-EP
Origin and Cause Report	
Working Hypotheses Development:	
Document a hypothesis for each reasonably possible origin/cause supported by the data/fact analysis.	
EXAMPLE:	
Smoking: The fresh cigarette butt found adjacent to the specific origin was discarded while still burning and ignited the surrounding dry grass.	
Note: At this point, the investigator should be able to describe the working hypothesis or hypotheses which were developed based on the meaning applied to the reliable data.	

OUTLINE	AIDS & CUES
Note continued: Example of Working Hypothesis based on the data: A fresh rock strike was found within the Ignition Area in line with dozer tracks, corresponding to witness statements that prior to the fire a piece of tracked equipment had passed that location, and shiny metal fragments were collected during the search of the Ignition Area. Based on this data a working hypothesis that the fire was caused by a friction spark when a dozer drove over a rock should be documented in the narrative report.	
<u>Documentation – Report:</u> Origin and Cause Report Hypotheses testing: • Describe how you "tested" each hypothesis. EXAMPLE: Smoking: The relative humidity measured at the scene at the time of the fire was 37%. Scientific research (Countryman 1983) has shown that discarded cigarettes will not ignite dry grass at humidity levels above 22 to 25%. Therefore, smoking is excluded as a potential cause of the North Fork fire.	05-90-FI210-EP

OUTLINE	AIDS & CUES

Note: Once the working hypotheses that can reasonably be proposed, based on the data/facts available at the time, have been identified in the report, the narrative should reflect the process, including the specific data/facts which falsifies each hypothesis and which hypothesis is best supported by all the data/facts.

In the case where only one working hypothesis was supported by the data/facts, the narrative should reflect why the lone hypothesis was or was not falsified by any part of the data/facts. If the lone working hypothesis does not explain all of the pertinent data/facts, than the report may reflect the data/facts which resulted in a finding of undetermined and/or actions taken to gather further data/facts for consideration of other alternative hypotheses.

While the investigator and/or investigative team may conduct initial testing of the working hypotheses, further documentation of additional hypotheses testing may be included into the case file at a later date when appropriate. In that case, the investigator may submit an amended opinion addressing the further testing of the hypotheses.

In some cases the report may reflect that the data/facts support multiple working hypotheses. In such a case the report should address the data/facts relied upon which raises one of the hypotheses to the level of probable over other alternative hypotheses which only reach the level of possible. If no working hypothesis is supported by the data/facts to the level of probable, the report should reflect the conclusion that multiple hypothesis are possible and that until further data/facts can be reviewed, no conclusion as to origin and/or cause can be made.

OUTLINE	AIDS & CUES
Documentation – Report:	05-91-FI210-EP
Origin and Cause Report	
Conclusion/Select Final Hypothesis:	
List the ignition source, material first ignited, and the ignition sequence.	
EXAMPLE:	
On August 14th, 2011 Mr. Smith lit a fire in his burn barrel. He did not place a screen on the barrel to prevent the escape of embers, and he had not cleared flammable grass and vegetation from around the barrel. In addition, Mr. Smith did not stay to watch the fire and he did not have tools or water available to put out the fire. A burning ember was lofted out of the burn barrel by hot gasses and landed in the dry grass, igniting it. The fire then spread from Mr. Smith's property to the surrounding forest causing the West Canyon Fire.	
Note: The conclusion of the report should be based upon the data which has been articulated in the previous narrative, including references to attachments and supporting documentation. Once the investigator writes his/her conclusion in the narrative report, he/she should review the narrative report to see that by the time the conclusion is reached, the reader has an understanding of the methodology used, data/facts collected and analyzed, working hypotheses considered, and the data/facts which support the conclusion and opinion of the investigator(s). Remember, the investigator is being asked for their opinion based on the data/facts of the investigation.	

OUTLINE	AIDS & CUES
<u>Documentation – Report:</u> Origin and Cause Report - Summary • The person responsible for the case file will include the O&C report into the case file along with all other pertinent information. • The investigative case file is the compilation of all investigative documentation not just the Final Report or Origin and Cause report. Note: If special resources are brought in there will be "supplemental reports."	05-92-FI210-EP

OUTLINE	AIDS & CUES
Review Unit 5 Objectives: • Recognize what needs to be documented in a wildland fire investigation and when to document it. • Determine an appropriate method to document. • Recognize various items that may be included in an investigative file/case file. • Understand how to fully complete an origin and cause report. • Understand the roles of an INVF and/or case agent/case manager and how they interact. Answer students' questions.	05-93-FI210-EP

UNIT OVERVIEW

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 6 – Ignition Factors and Sources

Lesson 6A – Lightning, Campfires, Smoking, and Debris Burning

Time 1.5 Hours

Objectives

1. Define various terms associated with fire causes.
2. List the general cause categories.
3. Describe the ignition factors and sequences that are normally associated with each cause.
4. Describe the various indicators and physical evidence associated with each cause.
5. Outline specific investigation methods unique to each cause.

Instructional Method(s)

- Informal lecture
- Classroom discussion

Instructional Aids

☐ Computer with projector, screen, and presentation software
☐ Sign-in sheet
☐ Flip charts and markers

UNIT PRESENTATION

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 6 – Ignition Factors and Sources

Lesson 6A – Lightning, Campfires, Smoking, and Debris Burning

OUTLINE	AIDS & CUES
Present unit title slide. Present unit objectives.	6A-01-FI210-EP
Unit 6 Objectives:	6A-02-FI210-EP
1. Define various terms associated with fire causes.	
2. List the general cause categories.	
3. Describe the ignition factors and sequences that are normally associated with each cause.	6A-03-FI210-EP
4. Describe the various indicators and physical evidence associated with each cause.	
5. Outline specific investigation methods unique to each cause.	
The Fire Investigator's Challenge:	6A-04-FI210-EP
"You are looking for something that is usually quite small, that is probably quite black, and is in the middle of a whole lot of other black stuff."	

OUTLINE	AIDS & CUES
Introduction: Meeting this challenge can be difficult for the following reasons: • Origin incorrectly identified. • Ignition source: − Destroyed by suppression − Small and not readily visible − Buried under ash and debris − Unfamiliar and therefore overlooked − Arson “hot set” and removed − Remains consumed by the fire	6A-05-FI210-EP
Fire Cause Terminology: The following documents contain fire management terms that wildland fire investigators should be familiar with: • Guide to Wildland Fire Origin and Cause Determination Handbook (PMS 412) • NWCG glossary of wildland fire terminology • NFPA 921	6A-06-FI210-EP Handout for the NWCG glossary.

OUTLINE	AIDS & CUES
Fire Cause Terminology: Ignition Factors Ignition factors make up the ignition sequence: • Competent ignition source. • The type and form of first fuel ignited. • The circumstances or human actions that allowed the factors to come together. Note: Competent Ignition Source: Under normal conditions, forest fuels will ignite and burn when exposed to a heat source that is capable of raising them to a temperature of between 451° and 750° F. Research places the average ignition temperature at about 500-600° F. This relatively low ignition temperature creates an extensive list of potential competent ignition sources.	6A-07-FI210-EP
Fire Cause Terminology: Competent Ignition Source The source of heat that kindles a wildfire • Mechanical spark or electrical arc • Glowing ember • Open flame • Chemical reaction • Friction	6A-08-FI210-EP

OUTLINE	AIDS & CUES
Fire Cause Terminology: Ignition Source Location	6A-09-FI210-EP
Note: May tend to rest on top of the ash surface or burrow or settle due to weight, temperature, velocity, or degradation of the fuel.	
Examples: • On the surface of the ash – Match, cigarette butt, flat metal fragments, etc. • Below the surface of the ash – Welding slag, exhaust particles, large metal fragments, etc.	6A-10-FI210-EP
Fire Cause Terminology: Materials First Ignited • The host fuel bed that the ignition source first comes into contact with and sustains combustion. • Ground or surface fuels • One hour FDFM category • High surface-to-volume ratio, i.e., duff, grass chaffs, etc.	6A-11-FI210-EP
Note: Instructor needs to explain/define one hour, ten hour, and fine dead fuel moisture.	

OUTLINE	AIDS & CUES
Fire Cause Terminology: Ignition Sequence	6A-12-FI210-EP
The existing conditions, subsequent actions and sequence of events that bring a competent ignition source into contact with the materials first ignited *Also referred to as the "Cause" of the fire.*	
• Conditions:	6A-13-FI210-EP
− Burn barrels without screens or clearance	
− Adjacent flammable vegetation	
− Fire weather	
− Slope	
• Sequence of events/ actions:	
− Ignition of the material in the barrels	
− Airborne ember	
− Failure to attend	
Fire Cause Terminology: Fire Cause Categories	6A-14-FI210-EP
A general list of fire cause categories used for statistical reporting and fire prevention purposes.	
Note: Because they can be different, the student should be familiar with their agency's categories.	
• Lightning	6A-15-FI210-EP

OUTLINE	AIDS & CUES
• Campfires • Smoking • Debris burning • Incendiary • Equipment • Railroad • Children • Miscellaneous	
Note: For the purpose of this class these are the categories that will be used.	
Wildfire Cause: Examine each of the general fire cause categories. • Ignition sequence: The conditions, actions and events. • Circumstances: Evidence or things typically associated with the cause, including potential ignition source remains. • Investigation techniques: Specific investigation methods that may assist in establishing evidence of the cause.	6A-16-FI210-EP

OUTLINE	AIDS & CUES
Lightning: Title slide	6A-17-FI210-EP
Lightning: Ignition Factors:	6A-18-FI210-EP
• Discharged static electricity. • Associated with thunderstorm activity. • Series of short bursts approximately two inches in diameter, lasting for one-half second. • Cloud-to-Ground Strikes: − 100 million volts − 200,000 amperes − 54,000° F	
• Possess either positive or negative charge − Positive charge: 10% of all strikes − Negative charge: 90% of all strikes	6A-19-FI210-EP
• Positively charged strokes have greater fire starting potential. − Long single stroke, continuing current • Damage is the result of electrical resistance and current. • Stroke duration = likelihood of ignition	
Note: Suggest noting the lightning data regarding positive or negative strikes in the report.	

OUTLINE	AIDS & CUES
Lightning: Circumstances	6A-20-FI210-EP
• Recent electrical storm (hours/days/weeks)	
• "Sleepers" and "holdovers"	
• Scarring on trees and/or snags	
• Precipitated sap	
• "Needle shower"	
• Ballistic penetration of adjoining vegetation by needles and small twigs or splinters	
• "Blow-holes" at base of tree	
• Fulgurites	
• Splintered wood or vegetation	
• Lightning strike scar	6A-21-FI210-EP
− May be very visible, or	
− May be difficult to see	
• Tree may not always be standing.	6A-22-FI210-EP
• Spike top or blunted snags with no visible scar.	6A-23-FI210-EP
• Top is blown off and scattered.	
• Remains consumed in fire.	
• Charring in top of tree or visible damage that appears recent.	

OUTLINE	AIDS & CUES
• Striking low vegetation or directly into ground.	6A-24-FI210-EP
• Splintered limbs, needle shower, blowholes, disturbed soil, shattered rocks, fulgurites	
• Look for blowholes at or near the base of trees.	6A-25-FI210-EP
Lightning may also strike a fence, sending electrical current down the fence wires for some distance.	6A-26-FI210-EP
• Ignites wooden posts.	
• Ignites flammable vegetation in contact with wire.	
<u>Lightning: Circumstances - Fulgurites</u>	6A-27-FI210-EP
• Fused soil or rock at location strike discharges to ground.	
• Fulgurites may be found on the surface to more than 16 feet below surface.	
• Range in size from ¼ inch to two inches in diameter.	
• Color, size and shape may vary.	
• Generally resemble fused glass, but may have a sandy or rough exterior.	6A-28-FI210-EP
• Usually hollow and fragile.	
• Branch-like	

OUTLINE	AIDS & CUES
Lightning: Investigation Techniques	6A-29-FI210-EP
• Historic activity patterns	
• Remote area/no human activity	
• Physical evidence	
• Recent storm activity/weather conditions	
• Absence of other reasonable causes	
• Remains consistent with a holdover	
Lightning: Detection Systems	6A-30-FI210-EP
• Occurrence map can assist with confirmation/elimination.	
• Obtain through dispatcher.	
• Should not be completely relied upon.	
• Accuracy is approximately 500 meters with an 80% to 90% detection rate.	
• National Lightning Detection Network, Vaisala:	6A-31-FI210-EP
− www.vaisala.com / 520 806 7300	
• Total Lightning Network, Earth Networks:	
− www.earthnetworks.com / 800-544-4429	
• US Precision Lightning Network, WSI:	
− www.uspln.com / 978-983-6648	

OUTLINE	AIDS & CUES
Lightning: Investigation Techniques (cont.)	
Sample lightning data report	6A-32-FI210-EP
• Lightning should only be considered as a working hypothesis, when you have data that supports it.	6A-33-FI210-EP
• Data should be collected and analyzed to determine if a working hypothesis of lightning can be formed.	
Note: Document how the investigation tested lightning against the facts of the case and eliminated it to be or not to be a viable hypothesis.	
Campfires: Title slide	6A-34-FI210-EP
Campfire: Ignition Factors	6A-35-FI210-EP
• Fire that is kindled for:	
− Heat, light, warmth, cooking, religious or ceremonial purposes	
• Regulations address:	
− Attendance, clearance, periods of use, suppression tools and proper extinguishing	
• Violations often cause escaped fire and have history of large, damaging fires (e.g., Tahoe, Wallow)	

OUTLINE	AIDS & CUES
Note: Not all states and tribes have regulations addressing campfire use.	6A-36-FI210-EP
• Failure to properly extinguish • Lack of attendance • Improper clearance/construction • Careless placement • Fire play • Improper discarding of coals/ash • Improper use of accelerants • Careless discarding of matches • Camp stove malfunction	
Campfire: Ignition Factors (cont.) Primary ignition mechanisms • Aerial sparks or rolling materials • Creeping • Improper disposal of coals/ash • Radiant heat • Convection	6A-37-FI210-EP

OUTLINE	AIDS & CUES
• Exploding rocks – Examine each rock in detail Note: "Exploding rocks" generally occur when the rock contains moisture, is heated and the rock explodes, scattering fire embers when the rock explodes.	
Campfire: Ignition Factors (cont.) Sparks or rolling material • Origin downwind/downhill • Typically fairly close • Paper or cardboard is prime aerial firebrand material. • Origin in punky material or fine fuels. • Origin from sparks that emanate from rapid vapor expansion in wood will be close to fire. Note: Rapid vapor expansion in the burning wood causes the wood to pop and explode, often sending burning bits of wood outside the fire ring, igniting the fuel bed.	6A-38-FI210-EP

OUTLINE	AIDS & CUES
Campfire: Ignition Factors (cont.) Creeping escapes • Uncleared duff to edge of ring • Smoldering type escape • May appear as a “finger” burn pattern • Underground root system or other ignitable material • Unattended, abandoned or improperly extinguished fires Note: The photos are of the Wallow fire near Springerville, AZ in 2010.The fire was improperly extinguished when the two responsible individuals left to go fishing. Winds rekindled the fire and blew the embers out of the ring.	6A-39-FI210-EP
Campfire: Ignition Factors (cont.) Discarded coals/ash • Origin near original campfire • Coals/ash present at origin • May be exposed or buried under soil • Heat may be retained for hours/days	6A-40-FI210-EP

OUTLINE	AIDS & CUES
Note: Ashes that are discarded from home woodstoves or outdoor wood burners/home heating furnaces would have similar ignition factors to discarded coals/ash at campfires.	
Campfire: Circumstances • Recently used fire at or near origin. • Signs of human activity at or near the origin. • Residual heat in campfire may remain. • Not all campfires will be within rock rings.	6A-41-FI210-EP
Campfire: Investigation Techniques Documentation • Origin and ignition factors − Construction of the fire ring • Any regulation violations • Improper or lack of extinguishment	6A-42-FI210-EP
Note: An ignition factor of the escaped fire may be the poor or inadequate construction of a fire ring. The Hayman Fire (Colorado - 2002) was an intentionally set fire in a fire ring that had been manipulated to appear like an accidental escaped fire. **Standard defense will be that the fire was "out."**	

OUTLINE	AIDS & CUES
Campfire: Investigation Techniques (cont.)	6A-43-FI210-EP
Improper Extinguishment	
Inadequate amount of water used	
• Fire smolders under crust	
• Residual heat often detectable	
• Fire escapes through creeping/embers	
• May be a lack of white ash on surface where water was applied.	
Fire smothered with soil/rocks	6A-44-FI210-EP
• May smolder for hours or days	
• Presence of hot coals	
• Vent fumaroles may appear on surface	
• Organic matter may contribute to smoldering	
• Soil moisture/mineral content may extend smoldering period	
Note: Definition of fumarole: A hole from which hot gases and vapors escape.	

OUTLINE	AIDS & CUES
Fire abandoned	6A-45-FI210-EP
• Fine, white ash may be present on surface	
• Ash has fluffy, fragile appearance	
• Odor of fresh burning	
• Sift burned debris for evidence.	
Note: No physical signs there were any attempt to extinguish.	
Evaluate partially burned debris in the pit, i.e., paper, plastic, etc.	
• High temperature thermometer or other method to establish residual heat levels.	6A-46-FI210-EP
• Wildfires burning over old campfire rings will not generally re-ignite coals.	
• Witnesses, trail registers, permits, contracts may provide leads.	
• Physical evidence.	
<u>Smoking:</u> Title slide	6A-47-FI210-EP

OUTLINE	AIDS & CUES
Smoking:	6A-48-FI210-EP
Smoking caused fires are not limited to manufactured cigarettes. They can include fires caused by: • Cigarettes • Matches • Cigars • Pipe tobacco • Illegal substances	
Redsicker and O'Connor observed in *Practical Fire and Arson Investigation*, "Cigarettes have long been the scapegoat in cases where no other cause could be determined"	6A-49-FI210-EP
• To effectively assess the probability of a cigarette as a competent ignition source, consider the following: − Physical characteristics of the cigarette − Environmental factors − Physical placement factors	

OUTLINE	AIDS & CUES
Physical Characteristics of manufactured cigarettes • Chemically treated tobacco wrapped in paper • Cellulon, plastic or charcoal filter • Weight: 2/3 gram • Length: 45-90 mm • Interior core temperature of 1361-1541° F • Exterior tip temperature of 572-1200° F	6A-50-FI210-EP
Fire Safe Cigarettes • Designed primarily for safety with interior upholstery. • Informal research shows they may continue to burn in a wildland environment. • The tobacco itself is not chemically treated, the paper has two thicker bands to retard burning unless actively being smoked.	6A-51-FI210-EP
Note: Even if the cigarette is considered “fire safe” (FSC), in testing 30% are allowed to fail and the cigarette still meets the safety standard.	

OUTLINE	AIDS & CUES
Smoking: Ignition Factors	6A-52-FI210-EP
Physical Characteristics • Ash content varies and will affect temperature • Up to 20% shrinkage • Lifts up and away from fuel bed • Heat transfer primarily conduction and radiation unless suspended in fuel • Linear progression limits exposure to 1-2 minutes • Total burn time approximately 12-15 minutes	
Environmental Factors • Finely particulated fuel bed • Loose fuel arrangement • FDFM of <14% • 80°+ ambient temperature (F) − Micro climate location (temp at ground level vs temp at higher level) • RH of 22% or less	6A-53-FI210-EP
Note: Discuss the micro climate issues on the ground and ensuring temp readings are taken in nearby unburned fuels at time of estimated ignition.	

OUTLINE	AIDS & CUES
Physical Placement Factors (cont.) • 30%+ of the glowing tip in contact with fuel bed • Tip oriented into wind • Tip burrowed or downslope Note: It's important to identify what the cigarette position was when it ignited the fuels, not its final resting place after the fuels ignited and burned.	6A-54-FI210-EP
Physical Placement Factors (cont.) • Roadside starts will generally be on or within few feet of road edge because the vortex effect pulls cigarette back toward pavement. • Next car blows cigarette to road edge. • Trajectory testing supports maximum thrown distance of approximately 20 feet.	6A-55-FI210-EP

• Cigarettes are limited as a competent ignition source.
  − Formal and informal research
• Very narrow window of ignition factors.
• Example:
  − RH: 21%,
  Temp: 68° F
  Wind: 10 mph
	6A-56-FI210-EP

OUTLINE	AIDS & CUES
Note: Optimum winds 2-5 mph. Lower winds result in lower oxygen flow while winds higher than 5 mph tend to disperse the heat needed to raise the fuel to ignition temperature.	
Smoking: Circumstances • Weather • Fuel bed • Physical placement • Human activity in origin area	6A-57-FI210-EP
Note: Smokers normally don't discard full length cigarettes. The length of the ash remains should be examined and consideration given to being part of a time delay incendiary device. Consider altered cigarettes, i.e., match-head device, cut back behind suppressant rings.	
• Rounded or pointed tip may indicate active smoking • Flat tip may indicate prior extinguishment • Exploded appearance on ash column • Old remains may have a bent, weathered or mangled appearance	6A-58-FI210-EP
Note: Exploded appearance of cigarette indicates the cigarette was in place as the fire burned over it. Likely not the ignition source.	

OUTLINE	AIDS & CUES
Cigarette Photo example:	6A-59-FI210-EP
Note: Physical evidence of ignition source. • Remains are fragile • May not survive • May only be the charred filter • Progressive burning • Exploded appearance may indicate old remains	
Debris Burning: Title slide	6A-60-FI210-EP
Debris Burning: Residential • Pile burning • Burn barrel Industrial • Logging operations • Land clearing • Agricultural • Forestry	6A-61-FI210-EP

OUTLINE	AIDS & CUES
Debris Burning: Ignition Factors • Factors are similar to escaped campfires. • Windblown embers or creeping into un-cleared vegetation. • Rely on fire indicators.	6A-62-FI210-EP
Debris Burning: Circumstances • Discernible spread pattern • Windblown embers generally within 40’ • Cardboard and paper competent aerial firebrand • Debris pile or burn barrel at or upwind of ignition area • Defective or no screen • Defective barrel • Inadequate clearance • Lack of attendance/suppression tools • Holdovers - days/weeks/months	6A-63-FI210-EP

OUTLINE	AIDS & CUES
Debris Burning: Investigation Techniques • Documentation of burn pattern/ conditions • Aerial firebrand sources usually upwind of ignition area • Examine source: − residual heat − violations − evidence of attempted extinguishment • Interviews	6A-64-FI210-EP
Incendiary: Title slide	6A-65-FI210-EP
Incendiary: • Fires that are willfully set without authorization. • Fires that are deliberately set to cause damage or to defraud: Arson. • Will be addressed later in separate unit.	6A-66-FI210-EP
Answer students' questions.	

UNIT OVERVIEW

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 6 – Ignition Factors and Sources

Time 1.5 Hours

Lesson 6B – Equipment Use, Railroad

Instructional Method(s)

- Informal lecture
- Classroom discussion

Instructional Aids

- ☐ Computer with projector, screen, and presentation software
- ☐ Sign-in sheet
- ☐ Flip charts and markers
- ☐ INSTRUCTOR: please confirm the two movie clips 1) Field Test Emissions and 2) Field Test Clean are embedded in Slide 47 are linked to the slide before presenting this unit.

UNIT PRESENTATION

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 6 – Ignition Factors and Sources

Lesson 6B – Equipment Use, Railroad

OUTLINE	AIDS & CUES
Present unit title slide.	6B-01-FI210-EP
Equipment Use: Title slide	6B-02-FI210-EP
Equipment Use: Ignition Factors	6B-03-FI210-EP
• Fires that occur from the operation of mechanical equipment, except railroads.	
• Will review five main ignition mechanisms.	
1. Exhaust system particles	6B-04-FI210-EP
2. Friction and sparks	
3. Fuel, lubricant, fluids	
4. Mechanical breakdown or other malfunction	
5. Radiant or conductive heat transfer	

OUTLINE	AIDS & CUES
Equipment Use: Ignition Factors Exhaust System Particles: • Originate from any internal combustion engine • Carbon, catalytic converter and metal fragments • Common ignition source Note: Can also get ignition from wood chip particles that have settled into the exhaust pipes of the wood chip trucks.	6B-05-FI210-EP
Equipment Use: Ignition Factors Exhaust System Particles System Configuration • Header • Converter • Exhaust pipe • Muffler • Tail pipe	6B-06-FI210-EP

OUTLINE	AIDS & CUES
Equipment Use: Ignition Factors	6B-07-FI210-EP
Exhaust System Particles	
Exhaust Carbon Particles	
• Materials from incomplete combustion of hydrocarbon fuels.	
– Engine carbon, trace metals	
• Lubricants serve as binder.	
• Heat content equivalent to a similar sized piece of hardwood.	
• Volatile hydrocarbons may extend the time particle is thermally active.	6B-08-FI210-EP
• Larger particles may auto-ignite upon ejection.	
• Diesel engines more prone to ejecting competent ignition sources.	
Equipment Use: Ignition Factors	6B-09-FI210-EP
Exhaust System Particles	
Gasoline Carbon	
• Generally smaller particles than diesel.	
• Granular or flakes	
• May be either shiny or dull, but will usually be sooty.	

OUTLINE	AIDS & CUES
• May be recoverable with a magnet if sufficient ferrous material present. Note: Ferrous material in carbon comes from engine piston ring and cylinder wear.	
<u>Equipment Use: Ignition Factors</u> Exhaust System Particles Diesel Carbon • Generally larger than gasoline carbon • Granular particles or spongy, pumice-like chunks • Shiny or dull • Usually black and sooty • Rarely recoverable with magnet	6B-10-FI210-EP
<u>Equipment Use: Ignition Factors</u> Exhaust System Particles • Particles originate from: – Combustion chamber (3,000° F) – Ports and manifolds (1,600° F) • Max. horizontal flight distance 45 feet	6B-11-FI210-EP

OUTLINE	AIDS & CUES
• Most fires will be much closer to source. • Competent ignition source: – Min. particle size of .023 in. (Fairbanks and Bainer) – Usually particles - 0.06 to 0.08 in. or larger (Riverside Fire Lab) – Particles up to 0.5 in. and larger not uncommon	
Note: Riverside Fire Lab is the Forest Service facility in Riverside, CA.	
Equipment Use: Ignition Factors Exhaust System Particles Exhaust Carbon Particles are usually ejected under following conditions: • Idling prior to peak level operation • Engine is pulling load • Piston ring or valve seal failure • Engine overheating • Jake brake operation, compression braking or shift point	6B-12-FI210-EP

OUTLINE	AIDS & CUES
Equipment Use: Ignition Factors Exhaust System Particles Exhaust Carbon Particles • Low RH and high temperatures • Variations in particle size make establishing minimums difficult • Large particles start fires up to 80% RH – Riverside Fire Lab • Host fuelbed finely particulated • FDFM generally low, but no known upper threshold	6B-13-FI210-EP
Equipment Use: Ignition Factors Exhaust System Particles Exhaust Carbon Particles - Origins: • Cutbanks, slopes, tunnel portals • Downgrades and at shift points on upgrades • Road conditions that contribute to thermal or mechanical stress	6B-14-FI210-EP

OUTLINE	AIDS & CUES
Equipment Use: Ignition Factors	6B-15-FI210-EP
Exhaust System Particles	
Exhaust Carbon Particles	
Spark Arrestors and turbo-chargers	6B-16-FI210-EP
• Designed to limit carbon ejection.	
• One or other may be required by law.	
• Presence does not preclude fire due to malfunction, modification, or wrong model.	
• Two categories	
– Attrition	
– Retention	
• Must meet standards	
• Spark Arrestor Field Guide	
Note: Define retention vs attrition spark arrestors	
Equipment Use: Ignition Factors	6B-17-FI210-EP
Exhaust System Particles	
• Loose housing bolts, loose or warped flange	
• Separated exhaust port screen	
• Some mufflers look like spark arrestors	

OUTLINE	AIDS & CUES
Note: Faulty design (design defect) can lead to flanges and screens expanding at different rates causing gaps and escaped particles.	
Equipment Use: Indicators Exhaust Carbon Small equipment: chainsaws, ATV, lawn equipment, portable power equipment • Evidence of use near ignition area • Perform inspection of exhaust system	6B-18-FI210-EP
Note: Chainsaws Recent cutting activity. Personal use/industrial. Saw that discharges exhaust on cutting area or ground. No spark arrestor or malfunctioning spark arrestor Origin at or near cutting area Lawnmowers, weed-eaters, rototillers, etc. Many un-equipped with spark arrestors Used in Hazard reduction freshly cut weeds or grass near origin Origin close to activity Motorcycles, ATVs, OHVs May not be not equipped with spark arrestor, or spark arrestor modified Transient activity operators leave area before aware of fire Trails/tire impressions If cleanout plug is removed it is not an approved spark arrestor	

OUTLINE	AIDS & CUES
Equipment Use: Indicators Exhaust Carbon Heavy Equipment • Dozers, dump trucks, logging trucks, tractors, graders, skidders, etc. • Many turbo-charged but may still pose threat if system is damaged. • Indicators may be obvious. Note: Determine whether equipment has been near origin: disturbed soil, tracks, plowed fields, mowed brush, graded roads, skidded timber. Evidence should be in close proximity to origin area.	6B-19-FI210-EP
Equipment Use: Investigative Techniques Exhaust Carbon • Evidence/witnesses suggest carbon • Difficult to recover actual particle • Aided visual exam, magnet, debris removal, sifting • Forensic evaluation of equipment/evidence	6B-20-FI210-EP

OUTLINE	AIDS & CUES
Equipment Use: Ignition Factors Catalytic Converter Particles Composed of ceramic matrix • Honeycomb monolith • Small ceramic beads (older vintage vehicles) Note: Catalytic converter particles are made of ceramic with a coating of non-ferrous metal such as platinum, palladium or rhodium, therefore they cannot be picked up with a magnet.	6B-21-FI210-EP
Equipment Use: Ignition Factors Catalytic Converter Particles • Particles of wire mesh may also eject from catalytic converter and ignite fire. Note: Occasionally pieces of the wire mesh from the interior of the shell will eject and be high enough temp to cause ignition. The slightly curved rectangular piece next to the mesh is what holds the wire mesh together around the matrix. The mesh assembly is ferrous and therefore can be collected with a magnet.	6B-22-FI210-EP

OUTLINE	AIDS & CUES
Equipment Use: Ignition Factors Catalytic Converter Particles • Operating temperature can reach up to 1,380° F • Malfunctions usually caused by electronic ignition failure – Converter overheats o Matrix degrades and breaks apart o 2,400° to 2,800° F – Hot ceramic particles discharged from exhaust system Note: Catalytic Converter Particles • Hot converters do start fires. • Particles probably start more. • Catalytic reaction scrubs pollutants from exhaust. • Standard equipment on cars since 1975 and trucks since 1984.	6B-23-FI210-EP
Equipment Use: Ignition Factors Catalytic Converter Particles Origins • Horizontal trajectory approximately 35 feet maximum	6B-24-FI210-EP

OUTLINE	AIDS & CUES
• Close to road shoulder – No correlation to cutbanks or grades	
• Multiple ignition areas or multiple fires along same road system	
• Tailpipe height limits trajectory	
Equipment Use: Indicators	6B-25-FI210-EP
Catalytic Converter Particles	
• Particle(s) in ignition area	
• Particles may vary in size, up to diameter of tailpipe	
• Lightweight ignition source	
• Non-magnetic	
• Ricochet effect	
• Resembles melted plastic	
• Particle at origin of one of five fires (Note the grass stem indicators) See photo	6B-26-FI210-EP
• Grey color	6B-27-FI210-EP
• Dull or metallic sheen	
• May be scorched	
• Honeycomb matrix may be visible	
• Small beads	

OUTLINE	AIDS & CUES
Equipment Use: Investigative Techniques Catalytic Converter Particles • Multiple ignition areas • Walk roadside • Interview vehicle driver/owner • Approximately 33% of vehicles stopped running within a few miles of fire(s) • Inspection of converter – Look for holes, rust, cracks, loose mounts Note: Interview of vehicle driver and/owner concerning mechanical condition of vehicle and any recent repairs or modification. Interview should include documentation of vehicle performance prior to the fire occurring. Search for particles on road or shoulder that did not start fire. May be able to determine manufacturer from construction of matrix.	6B-28-FI210-EP

OUTLINE	AIDS & CUES
Equipment Use: Ignition Factors	6B-29-FI210-EP
Friction • Heat generated by moving object (s) – Sparks and/or high temperature particles • Can be associated with a mechanical malfunction	
Note: Sparks and/or metal particles can be ejected in showers near a single location. Sparks may become luminescent and burn up entirely, often leaving only remnant metal particles as indicators of frictional failure.	
This picture depicts a cable rub on a cable logging operation. • Spark temperature – May reach several thousand degrees • Larger particles shear off – 700° to 1500° F • Combustible object is contacted by rapidly moving object	6B-30-FI210-EP
Note: This picture is a hot saw strike on a rock with metal fragment transfer. Note the heat tinting (blue color) on the metal fragments on the rock.	

OUTLINE	AIDS & CUES
Equipment Use: Ignition Factors	6B-31-FI210-EP
Friction	
Examples of potential ignition sources:	
• Cable rub	
• Tracked equipment	
– Roller pins bind	
– Slip/spin on rock	
• Grader strikes	
• Rotary saws/hydro axes	
– Contact rocks	
– Misaligned shaft	
– Vegetation buildup	
Note: Look for metal scrapings on the rocks or hard surfaces themselves.	
Equipment Use: Investigation Techniques	6B-32-FI210-EP
Friction	
• Evidence of equipment use at ignition area.	
• Use a magnet.	
• Fire may start after operators left area.	

OUTLINE	AIDS & CUES
• Over-aggressive operation • Examine cutting teeth for damage. • Friction charring on stumps. • Submit metal particles/control samples for forensic evaluation.	
Note: Magnet use – evidence may be on surface or buried under ash/debris.	
Over-aggressive operation such as knocking down of non-merchantable material, dragging of saw head.	
<u>Equipment Use: Ignition Factors</u>	6B-33-FI210-EP
Fuel/Lubricant/Fluids Ignites from heat source and spreads to wildland. • Refueling • Fuel line leaks • Hydraulic line leaks • Combustible debris accumulations – Engine compartment – Near exhaust system	
• Hydrocarbon/fluid residue • Trails of burned vegetation	6B-34-FI210-EP

OUTLINE	AIDS & CUES
• Burned equipment at origin • Witness statements	
<u>Equipment Use: Ignition Factors</u> Mechanical Breakdown • Tire/wheel/bearing failure • Hydraulic line failure, fluid release • Brake failure • Transmission failure • Electrical system failure • Dragging tow chains, binders, exhaust systems, driveline, etc.	6B-35-FI210-EP
Note: The hydraulic fluid is at high pressure and it may vaporize when the line fails, the vapor then comes in contact with a heat source, igniting the grasses or other wildland fuels it comes in contact with.	
• Failed turbocharger – Metal fragments • Seized bearings – Metal fragments • Misaligned axle – Tire ignites	6B-36-FI210-EP

OUTLINE	AIDS & CUES
Equipment Use: Investigative Techniques	6B-37-FI210-EP
Mechanical Breakdown • Evidence of equipment use near ignition area. – Locate vehicle • Metal particles – Use magnet and/or metal detector • Burned tire fragments – Match to original • Gouge or drag marks on road surface	
Equipment Use: Ignition Factors	6B-38-FI210-EP
Radiant or Conductive Heat Transfer • Radiant or conductive heat • Vegetation accumulation – Burning vegetation • Vegetation contact with hot engine or exhaust surfaces	
Accumulation of muskeg on rear axle of ATV: Photo	6B-39-FI210-EP
Smoldering organic material on ATV exhaust:	6B-40-FI210-EP

OUTLINE	AIDS & CUES
Equipment Use: Ignition Factors Radiant or Conductive Heat Transfer • Equipment activity in area • Possible trail of charred vegetation • Burned equipment • Charred vegetation – Exhaust system – Engine compartment	6B-41-FI210-EP
Railroads: Title slide	
Note: Locomotive Exhaust Stack Fire and Explosion on Union Pacific Locomotive 9807, Greenwich, Ohio. As of 9/07/12, this locomotive was still in service.	6B-42-FI210-EP
Railroad: Ignition Factors • Railroad fires include fires from any railroad operations, personnel, or rolling stock. • Historically, railroad fires are significant. • Aggressive prevention has reduced occurrences.	6B-43-FI210-EP
Note: Historically railroads have caused many significant fires.	

OUTLINE	AIDS & CUES
Railroad: Ignition Factors RR fire ignition mechanisms: • Exhaust carbon particles • Brake shoe metal backing plate particles • Track maintenance (MOW) • Right-of-way maintenance • Dynamic grid failure • Signal flares • Wheel slip • Wheel bearing failure (hotbox) • Transients Note: Torpedoes placed on the Railroad Track, Old Style Journal boxes are not as common today. Torpedoes were used as a warning device for train crews. The old style journal boxes may still be used on excursion trains. MOW – Maintenance of Way	6B-44-FI210-EP
Railroad: Ignition Factors Exhaust Carbon Particles • Highly competent ignition source • Diesel carbon is bound together with polymeric lubricant resins	6B-45-FI210-EP

OUTLINE	AIDS & CUES
• Pumice-like appearance but may be granular or flaky • Often sooty/oily • Range in size • Rarely retrievable with magnet	
Note: Exhaust particles emitted from a point in the exhaust stack might range from 900° F to 1,200° F. Under fanned conditions, which simulate an in-flight environment, exhaust particles have been observed as low as 690° F. Depending upon their size, structure, and surrounding environment, they could be either cooled or have their temperature significantly raised from increased thermal activity. As the hot exhaust particle passes from an oxygen-depleted environment to the atmosphere, glowing or flaming combustion can occur. – Luigi DeBernardo	
<u>Railroad: Ignition Factors</u> Exhaust Particles • Auto-ignition creates flaming projectiles. • Thermally active for 30 seconds or longer. • Swirling air from passing train – aids in ignition of vegetation and ejection distance of the carbon particles along with any wind that maybe present. • Riverside Fire Lab research puts maximum in-flight distance at approximately 45 feet or more.	6B-46-FI210-EP

OUTLINE	AIDS & CUES
<u>Railroad: Ignition Factors</u> Exhaust Particles Infrared video of locomotive discharging exhaust carbon particles. Note the number of particles, trajectory and distance they travel.	6B-47-FI210-EP
INSTRUCTOR: please confirm the two videos, 1) Field Test Emissions and 2) Field Test Clean are linked to Slide 47 before presenting this unit.	Click on each photo to start video.
Note: This video was taken in 2000 in Alberta, Canada. The video was filmed with the cooperation of the railroad and the governmental agencies. Note the ejection of the flaming carbon on both sides of the railroad track and the non-consistent ejection pattern as the train moves forward.	
<u>Locomotive exhaust systems:</u>	6B-48-FI210-EP
Note: These are the different types of exhaust systems you'll find on both the EMD or GE locomotives. The Roots Blower type will be found on older, non-turbo locomotives. These photos show the differences of the exhaust stack as you look on top of the locomotive.	

OUTLINE	AIDS & CUES
Carbon traps: • Cup type trap • Bin type trap Both style of traps become ineffective when about 1/2 to 2/3 full. Note: The cup traps in the left photo shown are full of carbon. The bin trap in the right photo has a dry flaking type carbon in the lower portion of the retention bin which is attached to the internal spark arrestor.	6B-49-FI210-EP
Carbon caused Fire from a turbocharged locomotive: Note: The origin area (red arrows) is in the left photo in the ballast area below the railroad tracks. In the right photo, you are looking in the opposite direction of the same fire. Note the dried vegetation in the ballast area that may have been missed when the railroad was conducting a spraying program. The fireguard had not been maintained and contributed to the spread of this fire. Check your state/ local laws and regulations in regards to maintaining vegetation and fireguards in the railroad right of way. This was a carbon caused fire from a passing locomotive on a track approximately 40 feet from the origin area. At the time of the fire there was a crosswind.	6B-50-FI210-EP

OUTLINE	AIDS & CUES
Railroad: Ignition Factors Brake Shoe Particles • Majority of trains are diesel-electric combination. – Air brakes and dynamic braking (electrical) – Non-metallic composition brake shoe pads • Fires may occur when brakes are applied. – Metal backing plate particles shear off and land on ties or vegetation. – Malfunctioning brakes start fires at any location o Stuck brakes o Set brakes Note: • Brake shoes must be regularly maintained. • Composition pads wear down. • Some older equipment may be equipped with metal shoes. • Some trains now use disc brakes.	6B-51-FI210-EP

OUTLINE	AIDS & CUES
Railroad: Investigation Techniques Brake Shoe Particles • Use magnet to assist in recovering particle. • Stop train immediately – May be stopped by hotbox or dragging equipment detector. • Obtain necessary maintenance records. – Hotbox detector records • Forensic evaluation as necessary. Note: The photo depicts a hotbox detector. The yellow box- like fixtures adjacent to the outside of the rails are the detectors. The detectors are designed to detect the temperature of the rail wheel bearings and may "sometimes" detect a dragging brake shoe if the rail wheel is hot enough and causes a drag on the rail wheel bearing. These detectors are not specifically designed to detect dragging brake shoes.	6B-52-FI210-EP
Railroad: Ignition Factors Track Maintenance • Track wear requires regular maintenance. • Includes: – Standard welding and cutting – Thermal chemical catalyst welding – Grinding	6B-53-FI210-EP

OUTLINE	AIDS & CUES
Note: Catalyst welding.	
• Hot ceramic molds carelessly discarded or buried in fill.	
• Open flames/sparks.	
Track Grinding	
• Manual grinding	
• Machine grinding	
• Sparks and hot grinder residue	
• Recoverable metal particles (magnet or metal detector)	
<u>Railroad: Ignition Factors</u>	6B-54-FI210-EP
Track Maintenance	
• Evidence of recent maintenance operation.	
– Fresh welds/grinds	
– Recent tire impressions on right-of-way.	
• Welding/cutting/grinding slag and debris	
• Discarded molds	
• Supply boxes	
• Campfires/debris burns	

OUTLINE	AIDS & CUES
Note: Recover metal particles with magnet/metal detector, interview maintenance crew, obtain necessary records.	
<u>Railroad: Ignition Factors</u> Right-of-Way Maintenance • Burning • Mowing • Tree trimming • Brush removal • Maintaining the Right-of-Way with mechanical equipment.	6B-55-FI210-EP
<u>Railroad: Investigation Techniques</u> Right-of-Way Burning • Physical evidence • Thorough documentation of actual escape location • Obtain records – Permits – Work records • Interview work crews	6B-56-FI210-EP

OUTLINE	AIDS & CUES
Railroad: Ignition Factors Dynamic Grid Failure • Traction motors converted to generators when dynamic brakes applied. • Energy turned into electrical current, routed to resistor grid on locomotive. – Resembles large toaster elements. – Location on engines varies. • Excess heat vented through fans. • May overheat/fail with spectacular arcing and violent ejection of hot metal fragments. • Downgrade – Where dynamic or blended braking is applied.	6B-57-FI210-EP
Dynamic Brake Grid Failure: Note: There is a cooling fan on the top of the locomotive car body which helps dissipate the heat generated from the application of the dynamic brake by the engineer. On occasions, this cooling fan may fail and cause an explosion which may shower the rail bed, ballast and adjacent right of way with hot metal particles. This failure is often accompanied by a loud noise that may be noticed by the train crew. The grid material may or may not be picked up by a magnet due to some of the non-ferrous material of the brake grid. The brake grids may produce 600 volts, use extreme caution around them.	6B-58-FI210-EP

OUTLINE	AIDS & CUES
Railroad: Ignition Factors Signal Flares • Train stops at unregulated crossing • Hot slag • Carelessly discarded flare	6B-59-FI210-EP
Locomotive Wheel slip: Note: Wheel slip can be caused by excessive acceleration, or when a substance such as sand, oil, or ice has built up on the top of the railroad track. This results in not only deterioration of the track, but also metal can be cast off. If the metal material is hot enough and the receptive fuel bed is dry enough, ignition can occur. Investigators should note the condition of the track adjacent to the fire origin area. The blue pen in the foreground is pointing to a metal fragment that is a result of wheel slip.	6B-60-FI210-EP
Rail Car Axle Bearings: Note: The photo on the left depicts a rail wheel with a roller bearing hub assembly. The photo on the right depicts a roller bearing assembly that has been detected as defective by a hot box detector. This axle assembly has been removed from a rail car and tagged as “Bad Order”. “Bad Order” is a railroad term for a defective item or items.	6B-61-FI210-EP

OUTLINE	AIDS & CUES
Rail Car Wheel Bearing Hub Failure:	6B-62-FI210-EP
Note: These roller wheel bearings were ejected from a rail wheel hub and cast out onto the Railroad Right of Way. Note the roller bearing on the right, the vegetation which was under this bearing is burned which indicates the bearing was hot when it was ejected. The tie area under the bearing in the left photo was also burned when the bearing was moved-rolled over.	
PERSONAL PROTECTIVE EQUIPMENT (PPE): • Hard hat • Eye protection • Hearing protection • Approved footwear and leather gloves • High visibility reflective vest	6B-63-FI210-EP
Note: This photo was taken in the BNSF yard, Pasco, WA.	
Rail Safety: • Blue Flag (Signal) • Always step over the rail • Switch Safety • The “Red Zone”	6B-64-FI210-EP
Answer students’ questions.	

UNIT OVERVIEW

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 6 – Ignition Factors and Sources

Lesson 6C – Children, Miscellaneous

Time 1 Hour

Instructional Method(s)

- Informal lecture
- Classroom discussion

Instructional Aids

- ☐ Computer with projector, screen, and presentation software
- ☐ Sign-in sheet
- ☐ Flip charts and markers

UNIT PRESENTATION

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 6 – Ignition Factors and Sources

Lesson 6C – Children, Miscellaneous

OUTLINE	AIDS & CUES
Present unit 6C title slide.	6C-01-FI210-EP
Children: Title slide	6C-02-FI210-EP
Children: Ignition Factors • Person 12 years or younger • May be motivated by curiosity • Experimental or play • Matches, lighters, or magnifying glasses • Fireworks and accelerants • May involve multiple children	6C-03-FI210-EP

OUTLINE	AIDS & CUES
Children: Indicators • Appearance of fire play – numerous matches or matchbooks – burned toys – cigarettes – paper – boxes • Origins away from adult supervision – Hidden or “secret” areas – Forts	6C-04-FI210-EP
Children: Indicators • Children responsible will often flee scene. – May return later to watch suppression. – Uninvolved children are curious and sometimes go towards fire.	6C-05-FI210-EP

OUTLINE	AIDS & CUES
Children: Investigative Techniques	6C-06-FI210-EP
• May be corresponding pattern of fires associated with structures, schools, or playgrounds.	
• Attempted suppression in early stages by civilians.	
• Children in area with charred clothing or shoes.	
• Evidence of unsophisticated suppression at origin.	6C-07-FI210-EP
• Often an abundance of evidence (e.g., footwear impressions).	
• Neighborhood canvass for witnesses.	6C-08-FI210-EP
• Children who frequent area.	
• Other incidents of fire play.	
• Involve/not involve parents.	
• Skillful interview techniques.	
• Children can lie effectively.	
– Most will be truthful through effective interviewing.	
• Consider referral to juvenile authorities.	
– Early juvenile fire setter intervention programs.	
Miscellaneous: Title side	6C-09-FI210-EP

OUTLINE	AIDS & CUES
Note: Catch-all category. The list is potentially endless. This unit discusses the more commonly encountered causes.	
Miscellaneous: Ignition Factors	6C-10-FI210-EP
Power lines	
• Power lines may start major fires due to:	
– Weather conditions	
– Remote locations	
• Grid forms a complex web.	
• Regulations govern fire prevention.	
• Investigator should be familiar with basic power transmission systems.	
• Transmission lines	6C-11-FI210-EP
– Generation facility to sub-station	
• Distribution lines	
– Carries power from sub-stations to the consumer	
– Statistically more likely to cause fires than transmission lines	
Note: Generation facility to sub-station. Higher voltage. Larger towers. Generally 138kv – 765 KV. Distribution lines – carry lower voltage. Carry more fire starting hardware, and have 5 to 10 times more line.	

OUTLINE	AIDS & CUES
Power lines: (cont.)	6C-12-FI210-EP
• Various hardware used	
– Switches	
– Fuses	
– Connectors	
• Failure of conductors and hardware	
• General familiarity important	
• CAL FIRE Power line Equipment Identification Pocket Guide	
• Will look at commonly encountered ignition factors.	6C-13-FI210-EP
– Conductor failure/faulting	
– Insulator failure	
– Miscellaneous hardware failure	
– Birds/small mammals	
– Mylar balloons	
• Conductor failure or faulting	6C-14-FI210-EP
– Breaks, falls to the ground, arcs, and starts fire	
o Splice or connector fails	

OUTLINE	AIDS & CUES
– Contacts or comes close to adjacent phase or vegetation and faults/arcs. o Line sag due to increased load, high winds, heat, bird flocks – Initial fault may not start fire; may occur with automatic reclosing of the circuit.	
Note: Line sag contact or proximity arc to adjacent vegetation. Proximity arc = 1 inch per 10 KV. Line may retract prior to arrival.	
• Conductor failure or faulting is usually obvious. – Charred vegetation – Line down or intact – Pitting and staining on conductor – Blowholes at base of tree – Resistance scarring on tree – Fulgurites at point of discharge	6C-15-FI210-EP
<u>Arc Charring on Branch:</u> Photo examples	6C-16-FI210-EP 6C-17-FI210-EP
<u>Pitting, staining and sooting on conductor:</u> Photo	6C-18-FI210-EP

OUTLINE	AIDS & CUES
Blowhole near base of tree: Photo example	6C-19-FI210-EP
Electrical resistance scar on tree trunk: Photo example	6C-20-FI210-EP
Miscellaneous: Indicators	6C-21-FI210-EP
Power lines - Conductor Failure	
• Fulgurites	
– Power line discharges to ground may leave fulgurites.	
– Shape and size may be different than lightning fulgurites.	
• Power line - Insulator Failure	6C-22-FI210-EP
– Variety of insulators.	
– Keep conductor from making grounding contact.	
– Failure can result in arcing to the pole or other hardware.	
– Fire often on crossarm and/or pole.	
– Dirt	6C-23-FI210-EP
– Bird manure	
– High humidity	
– Salt deposits (sea air)	

OUTLINE	AIDS & CUES
– Lightning strikes – Over-voltage – Deliberate damage – Current arcs – Insulators or crossarm fail and drop conductor	
<u>Power line Insulator Failure:</u> Photo example	6C-24-FI210-EP
Note: Insulator shows evidence of current flashover and arcing.	
<u>Miscellaneous: Indicators</u>	6C-25-FI210-EP
Power lines - Other Hardware • Non-exempt – Fuses – Disconnects – Lightning arrestors – Clamps – Connectors	
Note: Red arrow points to a tripped fuse. Can drop hot material to the ground	

OUTLINE	AIDS & CUES
Disconnects: • Solid blade disconnect • Inline disconnect Note: Disconnects: Isolates a section of line. When thrown, may arc, causing hot metal fragments fall to vegetation below.	6C-26-FI210-EP
Miscellaneous: Indicators Power lines - Other Hardware	
Lightning Arrestors • To protect equipment • Hot fragments	6C-27-FI210-EP
Connectors and clamps • Connect conductors and jumpers • Arc potential when loose – Hot tap clamps – Split bolt connectors – LM connectors – Fargo connectors	6C-28-FI210-EP

OUTLINE	AIDS & CUES
Connectors and Clamps: Examples	6C-29-FI210-EP 6C-30-FI210-EP 6C-31-FI210-EP
Miscellaneous: Indicators	6C-32-FI210-EP
Power lines - Birds and Small Mammals • Contact with two phases or transformer and jumper • Arc and catch fire • Is the utility company responsible for fires started by animals or birds?	
Note: Birds and small mammals: Creates fault, but often only momentary. Burned remains at the origin.	
Miscellaneous: Investigation Techniques – Power lines	6C-33-FI210-EP
General Investigation Considerations • Documentation and validation - critical – Photographs – Physical evidence – Measurements • Repair crews might leave with evidence – Consent or warrant if necessary • Most line crews will cooperate – Interview	

OUTLINE	AIDS & CUES
Miscellaneous: Investigation Techniques – Power lines • General Investigation Considerations – Collect all evidence. o Hardware o Forensic evaluation • Secure all relevant records from utility company. – Consider sending preservation letter. – Maintenance – Current flow/faults – Hazard reduction o Poles are numbered and coded for reference.	6C-34-FI210-EP
Miscellaneous: Investigation Techniques – Power lines General Investigation Considerations • Document any violations of vegetation clearance – Establish right-of-way boundaries • Obtain Forensic Electrical Engineer – Specializes in power line related analysis	6C-35-FI210-EP

OUTLINE	AIDS & CUES
Miscellaneous Power line Safety • Use extreme caution working under lines. • Assume conductor is charged. • Smoke and/or water spray can cause arcing. • Never climb a pole. • Wait for the arrival of utility crews to make line safe. • Look up, look out and stay away. Answer students' questions.	6C-36-FI210-EP

UNIT OVERVIEW

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 6 – Ignition Factors and Sources

Time 1 Hour

Lesson 6D – Miscellaneous (Continued)

Instructional Method(s)

- Informal lecture
- Classroom discussion

Instructional Aids

- ☐ Computer with projector, screen, and presentation software
- ☐ Sign-in sheet
- ☐ Flip charts and markers

UNIT PRESENTATION

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 6 – Ignition Factors and Sources

Lesson 6D – Miscellaneous (Continued)

OUTLINE	AIDS & CUES
Present unit title slide.	6D-01-FI210-EP
Fireworks: Title slide	6D-02-FI210-EP
Miscellaneous: Ignition Factors – Fireworks • May be classified in several different ways. − Depending upon jurisdiction • Examine function and ignition − Ground based and hand-held − Aerial − Explosive	6D-03-FI210-EP
Note: • Major property damage annually; wildland and structure • Used in an unsafe manner fireworks can discharge burning material into flammable vegetation	

OUTLINE	AIDS & CUES
Miscellaneous: Ignition Factors – Fireworks • Ground based and handheld − Emit flame and sparks − Adjacent flammable vegetation can easily ignite. • Types: − Base fountains − Cone fountains − Sparklers − Roman candles − Wheels and spinners − Smoke bombs	6D-04-FI210-EP
Miscellaneous: Ignition Factors – Fireworks • Aerial − Explode or aerial flash − May land in flammable vegetation. − May ignite vegetation at launch site. − May start a fire some distance from launch site.	6D-05-FI210-EP

OUTLINE	AIDS & CUES
• Types: – Bottle rockets – Parachutes – Wings – Mortars	
<u>Miscellaneous: Ignition Factors – Fireworks</u>	6D-06-FI210-EP
• Explosives – Flash powder charge – Can start fires. – Flaming paper particles may start fire immediately adjacent to blast area. – Strings or bricks of firecrackers or larger devices more likely: o Firecrackers o M-80 types o Cherry bombs	
<u>Fireworks Evidence</u>: Photo examples	6D-07-FI210-EP
Note: Holiday periods are the times more likely, evidence can include the spent device, residue from the explosion, and packaging material. Fragments of device may be buried in soil.	

OUTLINE	AIDS & CUES
<u>Miscellaneous: Investigation Techniques – Fireworks</u> • Ignition area and perimeter search • Identify responsible party • Witnesses • Forensic examination • Possibility of deliberate arson	6D-08-FI210-EP
<u>Firearms and Ammunition: Title slide</u> Note: A study conducted by the U.S. Forest Service Rocky Mountain Research Station in 2013 showed the probability of ignition of five types of rifle bullets at various impact angles in dry peat. Instructors of this unit should familiarize themselves with this research by reading the bulletin.	6D-09-FI210-EP
<u>January 2013 U.S. Forest Service Testing:</u> • Tests conducted using fourteen different rifle rounds, including steel, lead, and copper bullet components. • Target was hardened steel plate with oven-dried peat moss. • Ignitions were consistently observed with bullets made from steel components (core or jacket) and solid copper.	6D-10-FI210-EP

OUTLINE	AIDS & CUES
• Bullet weight did not affect the likelihood of ignition. • Some bullet fragments exceeded 1,400° F. • Lead core/copper jacket less likely to cause ignition.	

Note: Tech Tips, National Technology & Development Program, U.S. Department of Agriculture, Forest Service July 2013 1351 1301—SDTDC

<u>Key findings of tests</u>:

Rifle bullets striking hard surfaces can lead to ignition of organic material.

Tests were performed under conditions simulating critical fire weather (100-110° F, 7-10 percent relative humidity) and using highly receptive fuel bed (oven-dried peat moss with 3-5 percent fuel moisture).

Very small fragments can cause ignitions and may be difficult to locate at the origin.

Only rifle rounds, 7.62x54Rm 7.62x51 (.308 Winchester), 7.62x39, and 5.56x45 (.223 Remington) were used.

The probability of ignition increased with lower impact angles.

OUTLINE	AIDS & CUES

<u>Firearms and Ammunition:</u>
 	
• Blackpowder
  − Direct discharge into flammable vegetation
  − Flaming patch material
• Projectiles
  − Steel core AP
  − Incendiary
  − Tracer
  − Steel component
  − Lead core/copper jacket
  − Shotgun shells/flame
  − Other
 	
Note: Consider any projectile as a potential ignition source.
 	
Shotgun shells can be manufactured to expel flame and sparks.
	6D-11-FI210-EP

OUTLINE	AIDS & CUES
<u>Firearms and Ammunition:</u> • Steel core (AP) – Chinese or Russian surplus o .223/ 5.54 and 7.62x39 mm most common – Interior steel shank – Strike metal or rocks – True AP black or silver tip – Copper plated steel jackets o Magnet may not detect due to copper jacketing o X-ray	6D-12-FI210-EP
Note: Steel jacket rounds can be picked up with a magnet.	
<u>Firearms and Ammunition:</u> • Incendiary – Start fire upon impact o Phosphorous auto-ignites – Competent ignition source	6D-13-FI210-EP

OUTLINE	AIDS & CUES
− Military incendiary o Purple or blue tip − Available commercially o Various calibers o Dragon's Breath	
<u>Firearms and Ammunition:</u> • Tracer − Chemical mixture that burns briefly when fired. o Magnesium, strontium nitrate and oxidizer (calcium peroxide) − Available commercially − Military tracer o Red or orange tip	6D-14-FI210-EP
Note: Tracer rounds have a steel tip and hollow base and can be picked up by a magnet.	
<u>Firearms and Ammunition:</u> • Exploding Targets − Explode upon impact of projectile sending out hot particles.	6D-15-FI210-EP

OUTLINE	AIDS & CUES
• Investigator Safety Issues	
Note: Exploding targets can be commercially manufactured or homemade. Once mixed, they are classified as an explosive; remains should be handled, packaged and stored with caution. They cannot be legally transported after mixed (without an explosives license). YouTube video of low velocity exploding target starting a fire in the wildland. http://www.youtube.com/watch?v=HqxjgmYHQC0 -190k	
• Examples of brand names that may be at ignition area or in possession of shooters: − Tannerite − Star Targets − Sure Shot − Kick-Ass exploding targets	6D-16-FI210-EP
Note: Many of these products are binary explosives (meaning the individual components are not considered explosives until mixed). The exploding targets generally consist of a plastic container with ammonium nitrate that is then mixed with a small packet of aluminum powder. Research by the U.S. Forest Service indicates if the aluminum powder is not thoroughly mixed into the ammonium nitrate the target is more likely to erupt in a fireball. Exploding targets are not “fireworks.”	

OUTLINE	AIDS & CUES
• Exploding Targets: Physical Evidence at Scene − Debris field − Tiny white pellets − Container fragments − Packaging material − Pieces of plastic − Blast damage − Shell casings − Duct tape − Plastic baggies − Soda bottles	6D-17-FI210-EP

Note: Fires caused from exploding targets can be a distance from the site. This is primarily regulated by how big the device is. There is documentation of persons putting together up to 250 lbs. of explosives to detonate at one time, with flying material flying in excess of 100 feet. Most ignitions will be near the detonation point with most low velocity exploding target fires being at the site or within a short distance of the actual site of detonation.

Look for brand names of exploding targets at ignition area. Also look for shredded plastic from container. Debris Field/Blast Damage – depending on what it was sitting on.

OUTLINE	AIDS & CUES
Notes continued: Plastic remains – the size may range from very small to fairly large depending on whether or not the material was completely consumed/destroyed. Can be homemade targets with remains including signs of duct tape, other containers like soda bottles, plastic baggies.	
<u>Firearms and Ammunition:</u> • Evidence of shooting activity: − Metal appliances − Car bodies − Rocks near ignition area − Ammo boxes − Cartridge cases − Spent rounds − Bullet strikes − Targets	6D-18-FI210-EP
<u>Miscellaneous: Investigation Techniques – Firearms and Ammunition</u> • Physical evidence at scene − Locate spent casings − Metal detector	6D-19-FI210-EP

OUTLINE	AIDS & CUES
− Laboratory evaluation • Witnesses Note: Laboratory evaluation: attempt to match projectile and shell casing to firearm.	
Cutting, Welding and Grinding: Title slide	6D-20-FI210-EP
Cutting, Welding and Grinding: Ignition Factors	6D-21-FI210-EP
• Industrial operation − May be residential • Hot metal fragments or sparks • Finely particulated fuelbed • Particles will often burrow − Smoldering fire • Welder may be unaware • Welding particles generally within 10 feet • Grinding particles may exceed 40 feet • Larger particles more competent ignition source	

OUTLINE	AIDS & CUES
Cutting, Welding and Grinding: Indicators	6D-22-FI210-EP
• Physical evidence at origin:	
− Slag	
− Flux rods	
− Metal fragments	
− Discarded grinder discs	
− Welding cart wheel impressions	
− Fire extinguisher discharge residue or other evidence of attempted suppression	
Note: Fire extinguisher discharge residue or other evidence of attempted suppression relates to the OSHA regulations that may apply to welding activities.	
Cutting, Welding and Grinding: Investigation Techniques	6D-23-FI210-EP
• Evidence of welding	
• Interview	
− Witnesses and employees	
• Document weather conditions	
• Permit compliance (if required)	
• Magnet or metal detector to locate fragments	

OUTLINE	AIDS & CUES
Spontaneous Heating: Title slide	6D-24-FI210-EP
Note: Spontaneous combustion or ignition is ignition without an external heat source. Little understood process.	
Spontaneous Heating: Ignition Factors Three categories: 1. Material with low ignition temperature that will ignite when exposed to air. 2. Material that undergoes rapid oxidation at normal temperatures and generates heat. 3. Organic materials ignite as result of biological and chemical reaction.	6D-25-FI210-EP
Note: Organic materials ignite as result of biological and chemical reaction. Category 3, Organic materials igniting as result of biological and chemical reaction is the Category most likely to occur in a wildfire situation.	
Spontaneous Heating: Ignition Factors • Wood residue piled to 24” or greater • Moist/green material • Bacterial inoculation through soil mixing • Compacting	6D-26-FI210-EP

OUTLINE	AIDS & CUES
• Bacterial process raises core temperature to approximately 100 °F.	
Note: Different material (dry materials) may ignite at different depths.	
<u>Spontaneous Heating: Ignition Factors</u>	6D-27-FI210-EP
• High air temperature	
• High relative humidity	
• Bacterial die-off raises core temperature to 160 °F.	
• Chemical reaction	
• Thermal feedback causes pile collapse, oxygen intake.	
<u>Spontaneous Heating: Indicators</u>	6D-28-FI210-EP
• Pile of green material at ignition area.	
• Direct exposure to sun.	
• Witnesses reporting bad odors and/or steam.	
• Slime/mold/toadstools	
• Creosote-like substance oozing out of bottom of pile.	

OUTLINE	AIDS & CUES
Spontaneous Heating: Investigation Techniques	6D-29-FI210-EP
• Interview witnesses/workers.	
• Examine other unburned piles in area.	
• Forensic evaluation	
Miscellaneous: Coal Seam Fires	6D-30-FI210-EP
• Coal seam may be ignited by lightning, wildfires, or other ignition sources.	
• Fire burns slowly along the seam.	
• Resurfaces when seam nears surface and surface cracks, oxygen reaches the burning seam.	
• Dangerous to investigate.	
• Visible in winter with steam plumes and random bare patches in snow.	
• Dead vegetation.	
Note: Top picture shows the burning coal seam as it crosses under a road. Bottom picture shows the flaming coal seam at the surface. Dangerous to investigate because seam may be just under surface and surface may collapse under investigator/vehicle.	

OUTLINE	AIDS & CUES
Electric Fences: Title slide	6D-31-FI210-EP
Electric Fences: Ignition Factors	6D-32-FI210-EP
• "Weed-clipper" type most likely to ignite fire.	
• Late-spring/early summer occurrence.	
− Vegetation contacts wire.	
• Wire is wrapped around or contacts tree limb or wooden fence post.	
• Fires can occur from both braided wire as well as solid wire.	
Wire wrapped around tree trunk: Photo example	6D-33-FI210-EP
Electric Fences: Circumstances	6D-34-FI210-EP
• Burned-off stubble	
• Vegetation contact	
• Underwriter Lab approved control heads are not as likely to start fires.	
• Ignition area near or along fence line.	6D-35-FI210-EP
• Wire contact with vegetation.	
• Non UL approved control head.	

OUTLINE	AIDS & CUES
Note: Cannot rule out UL approved control head starting fire. Wire contact could be wildlife or insects.	
Electric Fences: Investigative Techniques	6D-36-FI210-EP
• Forensic evaluation at scene by qualified electrical engineers before dismantling.	
• Additional lab testing.	
Reflective Glass and Magnifying Objects: Title slide	6D-37-FI210-EP
Note: Very rare occurrence. Sunlight concentrated by either reflection or magnification. May have to be affirmatively excluded due to presence of object at origin. Flat broken glass, lacking magnification or reflective properties, will not start fires. Colored glass will not start fires.	
Reflective/Magnifying: Ignition Factors	6D-38-FI210-EP
• Objects known to have caused fires:	
− Cut crystal	
− Clear glass bottles filled with clear liquid	
− Headlight lenses	
− Mirrors	
− Old window glass (bubbled)	
− Unfrosted aerosol can bottoms	
− Polished metal	

OUTLINE	AIDS & CUES
Reflective/Magnifying: Investigative Techniques • Determine probable ignition time. • Document precise location, periods of exposure and orientation of the object to the sun. • Test object for its ability to focus sun's rays. • Recreate placement and fuelbed to determine ignition probability. Note: Presence of objects with reflective or magnification potential. Exclusion of other sources. Exposure to direct sunlight. Appropriate weather conditions.	6D-39-FI210-EP
Blasting: Ignition Factors • Fire started by flaming debris associated with blasting activity. • Near or in blast perimeter • Fire start may be delayed due to smoldering combustion.	6D-40-FI210-EP
Blasting: Investigative Techniques • Establish presence of blasting activity prior to fire. • Permits/fire suppression requirements.	6D-41-FI210-EP

OUTLINE	AIDS & CUES
• Attempt to recover foreign debris/material at ignition area	
Flares: Ignition Factors	6D-42-FI210-EP
• Mishandled or improperly placed	
• Hot cast-off material	
• Chemical compound contained in cardboard tube	
• Highly competent ignition source	
• Sometimes used as ignition source by arsonists	
Flares: Ignition Factors	6D-43-FI210-EP
• Aerial signal flares	
− Sold as emergency signaling device.	
− Some use standard caliber firearms.	
• Flare guns	
− Military surplus	
− Boating use	
− Used for prescribed fire by some agencies.	

OUTLINE	AIDS & CUES
Flares: Investigative Techniques	6D-44-FI210-EP
• Multiple flares along road edge. • Grayish-white slag • Ignition area adjacent to road edge. • Slag will test positive for strontium nitrates.	
Oil and Gas Fires: Ignition Factors	6D-45-FI210-EP
• Petroleum product flare stack/flare pit − Natural gas/oil − Wells and processing facilities − Flares fired to ignite gas can start fire − Stack can “burp” and start fire − Flames and/or carbon particles ignite adjacent fuels	
Note: Polyethylene pipe used to transport gas can form static electric charge on its exterior which can be the cause of fires, particularly during maintenance of the pipe or other activities associated with the pipe. The static electric charge creates tiny holes in the pipe, allowing the gas to escape.	

OUTLINE	AIDS & CUES
Oil and Gas Fires: Ignition Factors • Crude oil storage tank fires − Crude oil storage tanks − Carbon particles ignite adjacent wildland fuels.	6D-46-FI210-EP
Oil and Gas Fires: Investigation Techniques • Evidence of burning on stack • Ignition area in adjacent vegetation • Lack of clearance • Carbon soot particles • Records • Igniter flare residue • Ignition area may be downwind • Forensic evaluation of material in ignition area	6D-47-FI210-EP
Flying Lanterns: Ignition Factors • Miniature hot air balloon made from paper, bamboo and wire with a solid fuel package. • Capable of traveling great distances when released. • Commercial and homemade	6D-48-FI210-EP

OUTLINE	AIDS & CUES
Note: Originating in Asia and called “happiness balloons” or “wish balloons” their use has spread around the world and they are commonly used during weddings or other celebrations. Experimenting by young adults or teenagers is also commonly associated to fires caused by flying lanterns, particularly if homemade. Manufacturers claim that the paper is treated with a fire retardant but many are not. Can travel miles away from release site and are capable of reaching several thousand feet in altitude. Multiple lanterns may be released. The state of Oregon has classified flying lanterns as fireworks and banned them from use within the state.	
<u>Flying Lanterns: Investigative Techniques</u> • Physical Evidence − Wire frame − Pieces of bamboo − Paper remains or ash − Fuel package	6D-49-FI210-EP
Note: Photo shows paper remains, circular bamboo frame, and wire supports for fuel package. Release site may be a significant distance from the location of the fire. Remains of the balloon may be suspended above ground in vegetation or on structures. Determine wind direction and strength prior to the fire.	

OUTLINE	AIDS & CUES
Wind Turbines: Ignition Factors	6D-50-FI210-EP
• Common Failures − Lightning strikes − Gear box failures − Brake failure − Bearing failure − Blade failure − Generator failure − Construction and maintenance − Bird Strikes	
Note: Constant activities that occur around a wind farm, so the investigator should not assume that the fire ignited from a turbine. Other ignition activities around turbines may include: • Maintenance • Welding • Vehicles driving through dry grass	

OUTLINE	AIDS & CUES
<u>Home outdoor wood burning furnaces:</u> • Two major causes: − Discarded ash − Lack of maintenance of the chimney.	6D-51-FI210-EP

Note: Called either “outdoor wood furnaces” or “outdoor wood boilers”, these can be modern and efficient manufactured models or homemade models.

They can be used to heat a structure by way of connecting to a central heating unit and/or is used to provide hot water. Either way, the furnace operates by burning firewood and may be burning wood even in the warmer parts of the year if it is being used to heat water also. These units are typically located a distance from the structure and are most often enclosed in what looks to be a portable or constructed shed for insulation.

Home outdoor wood burning furnaces tend to have two major causes of fires, discarded hot ash from cleaning the furnace out and a lack of maintenance, including cleaning out the chimney. These types of furnaces tend to get less attention to maintenance than indoor wood heaters.

Ashes discarded from home woodstoves or outdoor wood burners/home heating furnaces. Would have similar ignition factors to discarded coals/ash at campfires

OUTLINE	AIDS & CUES
Review Unit 6 Objectives:	6D-52-FI210-EP
• Define various terms associated with fire causes.	
• List the nine national standard cause categories.	
• Describe the ignition factors and sequences that are normally associated with each cause.	
• Describe the various indicators and physical evidence associated with each cause.	6D-53-FI210-EP
• Outline specific investigation methods unique to each cause.	
Answer student questions	

UNIT OVERVIEW

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 7 – Arson Recognition

Time 3 Hours

Objectives

1. Define arson.
2. Describe the difference between arson and incendiary.
3. List the reasons why it may be difficult to solve wildland arson.
4. Identify arson investigation objectives.
5. Describe the indicators that identify an arson incident.
6. Recognize and describe a variety of arson ignition sources.
7. Identify the six arson motive categories and their subsets.
8. Describe the psychology of arson.
9. Describe the classification of arsonists.
10. Identify the general profiles and behavioral characteristics of the serial arsonist.
11. Describe how to identify and preserve evidence at the scene.
12. Describe notification and referral procedures to law enforcement.

Instructional Method(s)

- Informal lecture
- Classroom discussion

Instructional Aids

- ☐ Computer with projector, screen, and presentation software
- ☐ Sign-in sheet
- ☐ Flip charts and markers

UNIT PRESENTATION

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 7 – Arson Recognition

OUTLINE	AIDS & CUES
Present unit title slide. Present unit objectives.	07-01-FI210-EP
Note: This unit deals only with recognizing an arson incident. It doesn't go into arson investigation tactics or strategies—FI-310, Wildland Fire Investigation Case Development is the training course that covers that area.	
<u>Unit Objectives:</u>	07-02-FI210-EP
1. Define arson.	
2. Describe the difference between arson and incendiary.	
3. List the reasons why it may be difficult to solve wildland arson.	
4. Identify arson investigation objectives.	
5. Describe the indicators that identify an arson incident.	
6. Recognize and describe a variety of arson ignition sources.	
7. Identify the six arson motive categories and their subsets.	07-03-FI210-EP

OUTLINE	AIDS & CUES
8. Describe the psychology of arson. 9. Describe the classification of arsonists. 10. Identify the general profiles and behavioral characteristics of the serial arsonist. 11. Describe how to identify and preserve evidence at the scene. 12. Describe notification and referral procedures to law enforcement.	
DEFINITIONS	07-04-FI210-EP
<u>Arson vs. Incendiary: Is there a difference?</u> • ARSON: The intentional and wrongful burning of someone else's property or one's own property (as to fraudulently collect insurance). • INCENDIARY: Deliberately and unlawfully set fire to property. − Black's Law Dictionary, 9th Ed. 2009 <u>NOTE</u>: These terms are often used interchangeably, but it depends on jurisdictional interpretation.	
<u>Arson is a Criminal Act:</u> A Felony, punishable by: • Imprisonment of one year or more • Fine	07-05-FI210-EP

OUTLINE	AIDS & CUES
INTRODUCTION:	07-06-FI210-EP
• Arson may account for over 20% of all human-caused wildland fires.	
• 70% in some jurisdictions.	
• Probable that many arson fires are going unrecognized.	
• "Undetermined cause" should not be categorized as arson.	
• Mythology surrounding serial wildland fire-setting.	07-07-FI210-EP
− Based on anecdotal information not supported by research.	
− Institutionalized through "war stories" and training.	
− Myth vs. Reality.	
<u>Serial Arson:</u>	07-08-FI210-EP
Myths:	
• Numerous big fires that occur in rapid succession over short period.	
• Elaborate and sophisticated devices.	
• No physical evidence at the scene.	
• Random and unpredictable incidents.	
• Highly skilled and sophisticated offenders.	

OUTLINE	AIDS & CUES
Reality: • Small fires that may escalate in both frequency and severity. • No ignition source or a single match. • Physical evidence at the scene. • Recognizable and predictable patterns. • Unskilled and unsophisticated offenders.	
Note: These are serial arson facts.	
• The average serial arsonist is charged with 2.7 counts and convicted on 2.5 counts. • Suspected of setting an average of 35 fires before being apprehended. WHY???? − Origin and cause determination − Evidence collection − Linkage blindness	07-09-FI210-EP
Note: Have a discussion with the class about the following: Origin and cause determination – historically the O&C investigations have been poor. Not being able to exclude other causes.	

OUTLINE	AIDS & CUES
Notes continued: Evidence collection – not recognizing the evidence that needs to be collected or not following proper collection procedures. Linkage Blindness – not recognizing the linking factors. Not communicating fire activity to investigators.	
Early identification of an arson series is critical because: • Every fire set has potential for tragic consequences. • Fires may tend to escalate in frequency and/or severity. • Fires increase resource drawdown.	07-10-FI210-EP
Note: Additional charges can increase sentence. Additional charges more likely to result in plea bargain. Resource demand – unwanted fires increases the resource demand. Depletes initial attack capability.	
<u>Factors:</u> Arson may be a challenging crime to solve and prosecute due to a number of factors. Arsonists: • Work alone. • Conceal their activities to avoid detection.	07-11-FI210-EP

OUTLINE	AIDS & CUES
• Flee the scene.	
• Leave little obvious physical evidence.	
• Rarely confide in others regarding their activities.	
• Appear to function in a random and unpredictable manner.	
• The commission of the crime is short in duration.	07-12-FI210-EP
• Fire suppression activity may destroy or obscure evidence.	
• Eyewitnesses to the crime are uncommon.	
• Many prosecutors have little or no experience with wildland arson cases.	
• Arson motives may appear to be unfathomable.	
Note: Although arsonists appear to function in a random and unpredictable manner, they have recognizable and predictable patterns.	
"The real problem occurs when… investigators accept this bleak outlook as though it were fact… It has been our experience that most arson fires are not only possible to solve, in many cases, average arson fires are very easy to solve." (Corry and Vottero 1997, Criminal Profiling: Introduction to Behavioral Evidence Analysis by Brent Turvey.)	07-13-FI210-EP

OUTLINE	AIDS & CUES
Arson Investigation Objectives: • The role of the origin and cause determination investigator (INVF) is normally different than that of the investigator responsible for case development (INTM). • Understand your agency policy. Note: Discuss the difference between the INVF and INTM.	07-14-FI210-EP
Case Developer's Role (INTM): • Link apparently unconnected fires together. − Physical evidence − Pattern analysis • Develop investigation plan to identify the person responsible. − Forensic evidence − Behavioral evidence − Observation of fire setting • Arrest and charge. • Bring them to trial. Note: Discuss with the students their role in fire investigations as defined by their agency policy.	07-15-FI210-EP

OUTLINE	AIDS & CUES
Wildland Fire Investigator's Role (INVF): • Examine and analyze the fires you respond to for an indication of arson. • Protect and secure the area of origin, surrounding area and evidence. • Notification. • Confidentiality. • Assist as requested. Note: • Protect and secure the area of origin and keep security on scene until a qualified investigator arrives. • Follow your agency's procedures on notification and referral of a suspected arson case. • Do not assume or presume any law enforcement powers beyond those you are authorized to apply. • Maintain strictest level of confidentiality. • Share information only with those who "need to know." • Do not release any information to the media without agency approval.	07-16-FI210-EP

OUTLINE	AIDS & CUES
Indications of an Arson Incident:	07-17-FI210-EP
• Many arson fires go unrecognized. − Lack of overt evidence − Linkage blindness • The INVF is in the best position to detect arson pattern in early stages. − Awareness of indicators − Familiar with fire occurrence patterns	
Note: Linkage blindness is the failure to link similar arson fires. This may occur because of such things as poor communication between jurisdictions, failure to recognize similar patterns or MO of the arsonist on multiple fires, non-reporting of fire starts or reports not getting to the INVF, task force/case manager, etc.	
Often multiple sets may occur:	07-18-FI210-EP
• In same day. − Spree arson • Over weeks or months or even years. − Serial arson • In close proximity to each other. • Long distance apart. • In same or different agency jurisdictions.	

OUTLINE	AIDS & CUES
• Majority are accessed by motor vehicle. − Roads, ATV trails, power line ROW, etc.	07-19-FI210-EP
Note: Low risk access and egress. Offenders will more than likely look for easy quick access, with a low risk of being observed. There can be exceptions to this; however the reason isn't usually obvious.	
<u>Arson fire set along road edge: Photo examples</u>	07-20-FI210-EP 07-21-FI210-EP
Note: Question to Class: What indicators of arson incident do you see in this photo? Answer: Near highway, near access road off highway, also another trail leading into ignition area.	
<u>Indications of an Arson Incident:</u> • Recent occurrence of undetermined cause fires in area exceeding normal fire history. • Fires with no evidence of an ignition source. • Delayed ignition devices found. • Many arson starts are "hot-set." − Investigator must address other potential reasonable causes in the area of the origin.	07-22-FI210-EP
Note: Discussion about night time fire occurrence being related to serial arson. Local knowledge of fire occurrence is also important.	

OUTLINE	AIDS & CUES
<u>Patterns and Linkages:</u> • Fires may be connected by common patterns. • Linking factors: − Chronological − Geographical − Target Selection − MO • Example: Five fires occurring on Tuesdays and Saturdays, between 1400 and 1600 hours, on the same road system, paper match recovered on two of them. − Are they all connected?	07-23-FI210-EP
<u>Can you identify common denominators that link these fires?</u>	07-24-FI210-EP
Note: • All fires lit along the same road. • All fires occurred in grass. • All fires on the same side of the road. Background: Add the facts of the case. In this case, the offender (36 year old, Native Canadian) was under the influence of alcohol. He got in a physical confrontation with his girlfriend in a vehicle they were riding in. The driver of the vehicle threw the offender out of the vehicle. The offender was upset from the fight with his girlfriend and was walking along the roadway.	

OUTLINE	AIDS & CUES
Note continued: The first fire ignited at approximately 7:00 AM. Fires were "Hot Set". A witness came forward a year later with information on the fires, after seeing reward being offered. 1st fire – extinguished by a passerby 2nd fire – extinguished by a passerby 3rd fire – required fire suppression 4th fire – required fire suppression Fires occurred in succession toward town.	
<u>Arson Ignition Sources:</u> • Determination of the ignition source is an important aspect of the investigation. • Investigators should be aware of the various ignition sources.	07-25-FI210-EP
Arson Ignition Sources of Information: • Publications • Internet • Social Media	07-26-FI210-EP
Note: Suggest these and other sources of information to the students.	
Ignition sources may be characterized by how they are ignited: • Electrical reaction	07-27-FI210-EP

OUTLINE	AIDS & CUES
• Chemical reaction • Mechanical reaction Use origin and cause determination methodology to locate ignition devices located in ignition area. • Electrical and chemical arson devices − Relatively uncommon in wildland arson cases. − Mechanical devices are much more common. Note: Typically used to ignite vehicles and structures which may spread to the wildland. Chemical devices may consist of brake fluid and granular chlorine. <u>Ignition sources may be further characterized by:</u> • Ignition Function − Hot set − Timed • Delivery Method − Direct − Remote	07-28-FI210-EP 07-29-FI210-EP

OUTLINE	AIDS & CUES
Ignition Function: Hot Set • Any open flame applied directly to available fuels. • May be left at origin or removed. • Recent USFS research: − Approximately 80% of the offenders studied used a hot set device. − Offender may add to, rearrange or modify fuels to aid in ignition. Note: The type of device used is often dependent on the risk of detection, daytime roadside fires being more likely to use devices which can be thrown from a vehicle and not hot sets. Fires set in remote areas with only one egress route may increase the likelihood of a delay device being used. Student should be advised that the Forest Service study reflects fires occurring in a forest environment with reduced competent guardians present. Experience suggests that the percentage of hot sets is less in rural areas where higher risks of detection exist. Key point: The use of a device is normally associated with higher risk of detection or lower tolerance for risk by the offender. The use of a hot set is associated with a lower risk of detection and/or higher tolerance for risk by the offender.	07-30-FI210-EP

OUTLINE	AIDS & CUES
Ignition Function: Photo example	07-31-FI210-EP
Note: Grass and leaves piled at arson ignition area, manipulating the fuel bed.	
Not all arson fires are lit on the ground: Photo example	07-32-FI210-EP
Note: In this case in Saskatchewan, Canada, the 18-year-old arsonist attempted to light 6 fires along a forest trail. Four of the wildfires had to be responded to by fire suppression crews and a helicopter and bucket. The arsonist lit the draped moss from the jackpine branches with a lighter. Two of the fires (one pictured above) only burned the branch and did not get going.	
Draped moss makes excellent host fuel material for hot set: Photo example	07-33-FI210-EP
Ignition Function:	07-34-FI210-EP
Timed Ignition Sources • Incorporates a timer or delay mechanism. • Provides opportunity for the offender to flee scene (time-delay). • Cigarette and match or matchbook. − (Slow match) − Most common wildland time-delay device.	

OUTLINE	AIDS & CUES
Arson – cigarette match device: Photo example	07-35-FI210-EP
Note: For cigarette in left slide in middle, the sharpened wooden match would be pulled into the center of the cigarette by the arsonist. Paper matches may also be used with the head inserted entirely within the barrel of the cigarette and the stem of the match cut off leaving little outward indications of the match head. Ash may need to be examined for match head.	
Ignition Function: Timed Ignition Sources • Device may be weighted to enhance remote delivery. • Weight may be hidden under ash or lying nearby. • Examine area carefully. • Objects used as weights can include: coins, rocks, nails, nuts, bolts, washers, or any other small, heavy object.	07-36-FI210-EP
It takes a trained eye to locate these devices: Photo example	07-37-FI210-EP
Recovered cigarette and matchbook arson devices: Photo example	07-38-FI210-EP

OUTLINE	AIDS & CUES
Ignition Delivery Method:	07-39-FI210-EP
• Remote	
− Launched from a distance by hand or mechanical means.	
− Hot set or timed ignition source.	
• Direct	
− Hand-carried and placed.	
− Hot set or timed ignition source.	
Less Common Arson Ignition Sources:	07-40-FI210-EP
• Charcoal briquettes	
• Cotton rope	
• Incense sticks	
• Firework punks	
• Mosquito coils	
• Paper wrapped around a rock	
• Punky logs or stumps	
• Exploding targets	
• Ping pong ball/gunpowder	
• Concave shaving mirror	07-41-FI210-EP

OUTLINE	AIDS & CUES

- Commercial slash burning or backfiring devices
- Magnifying Glass
- Railroad or highway flares
- Candles
- Tracer/Incendiary bullets

Note: Concave shaving mirror placed to focus sun's rays. Multiple mirrors may be placed to set fires throughout the summer.

Commercial slash burning or backfiring devices. Limited availability. Blasting cap and jellied gasoline

Magnifying Glass. Used to focus sun's rays similar to shaving mirror.

Railroad or highway flares. Often launched remotely from moving vehicle. Telltale white slag. Striker cap may be found nearby or in suspect's possession. May be used as timed device by balancing on rock or setting one end in soil.

Candles. Regular candles or re-lighting "trick" birthday cake candles. Enclosed in flammable container to prevent extinguishment. Unburned container residue may be present at origin. May not melt entirely. Waxy residue below ash surface may also remain. Metal wick tab.

Tracer/Incendiary bullets. Available through military or commercial civilian sources.

OUTLINE	AIDS & CUES
Less Common Arson Ignition Sources: Accelerant • Ignitable liquid used to accelerate fire spread and intensity. • Not common in wildland arson cases. − 23% of convicted arsonists used it at least once. • Should be looked for routinely. Note: Investigator should look for evidence of an accelerant. Dark sooting, smell, burn patterns consistent with an ignitable liquid. Consider taking soil samples and/or using an accelerant detection K-9.	07-42-FI210-EP
Arson Motives: • Motive: The reason why someone commits a crime. − Does not need to be proven. − Motive is often relevant to the investigation and prosecution. • Motive is an emotional, psychological or material need that impels and is satisfied by a specific behavior, *i.e.*, setting fires. • Most wildland fire setting is motivated by an emotional or psychological need.	07-43-FI210-EP

OUTLINE	AIDS & CUES
Note: Should not use motive to support hypothesis of arson. Motive should be considered after arson has been established as a cause and used to identify suspect(s) and potentially link fires.	
FBI classifies arson into six major motive categories, with seven subsets:	07-44-FI210-EP
• Retaliation/Revenge • Excitement • Profit • Vandalism • Crime Concealment • Extremism/Terrorism	
<u>Arson Motives:</u>	07-45-FI210-EP
Retaliation/Revenge	
• Retaliation for a perceived injustice or wrong against the offender. • Subsets include: − Individual − Societal − Institutional − Group	

OUTLINE	AIDS & CUES
Excitement	07-46-FI210-EP
• Fires set to satisfy an emotional need to create excitement.	
• Subsets include:	
− Thrills	
− Attention	
− Recognition	
o Primary motive for firefighter arson.	
Profit	07-47-FI210-EP
• Planned to maximize property damage and not hurt people.	
• Insurance fraud.	
• Fireline arson.	
• Fire-setting firefighter or contractor motive.	
"*The blacker the forest, the greener the wallet.*"	
Vandalism	07-48-FI210-EP
• Nuisance type fires.	
• Simply for destructive purposes.	
• Young male offenders.	

OUTLINE	AIDS & CUES
• May have an accompanying pattern of nuisance or school related fires in nearby town. • Equipment in woods may be targeted. Note: Rarely against the natural resources themselves.	
<u>Crime Concealment</u> • Fire set to destroy the evidence of the primary crime. − Homicide − Vehicle theft • Scene security and evidence protection is particularly vital.	07-49-FI210-EP
<u>Evidence of the primary crime should be identified and protected</u>: Photo example	07-50-FI210-EP
<u>Extremism/Terrorism</u> • Fires motivated by political agendas. • In U.S., radical environmentalists have been associated with this activity. • Potential for non-domestic terrorism.	07-51-FI210-EP

OUTLINE	AIDS & CUES
Mixed Motives • Serial arsonists may have a mixture of motives. Power maintenance and anger may be underlying motivations for many arsonists. • Investigators should consider both primary and secondary motives.	07-52-FI210-EP
Miscellaneous Fire Setters: While not actually motives, the following groups often act with consistent motives. Indicators associated with these groups may also appear consistently. • Firefighter • Juvenile • Mentally disturbed • Female • Cultural	07-53-FI210-EP
Note: Firefighter arsonist: Being the "hero." Excitement, recognition or profit Juvenile fire-setters: Curiosity, "cry for help," or delinquent fire-setting in older youths. Vandalism, excitement or attention. Mentally disturbed fire-setter: a symptom of a mental disorder.	

OUTLINE	AIDS & CUES
Female fire-setters: Has increased in last few years. Retaliation, excitement or attention Cultural fire-setters: Based on past land management practices. Do not assume that the fire is culturally based just because of past cultural practices. Most current fires have roots in other motives. Vandalism, excitement, revenge, intimidation are common.	
<u>Psychology of Arson:</u> • Many mental health experts disagree on the mental state of arsonists. • Motivated by: − Criminal intent − Manifestation of an underlying mental illness • Investigator should focus on identifiable criminal motives. • Investigator <u>should not</u> attempt to diagnose the mental state of the offender.	07-54-FI210-EP
Note: “Pyromania” as a stand-alone mental disorder is essentially considered by many experts to be a myth. It is no longer in DSM5 (Diagnostic & Statistical Manual #5)	

OUTLINE	AIDS & CUES
• Many offenders state they would have continued lighting fires even if they had known they were going to be apprehended. • Fire setting may restore a feeling of power and control to offender who has little of either in his or her life.	07-55-FI210-EP
Note: Excerpts from psych evaluations: "He is a loner who has maintained few friends and has never married." "He describes himself as a wuss, stupid and feeling bad." He says, "I need some help. I have held so much inside for so long."	
The themes that consistently appear in psychological research and evaluations: • Poor social adjustment skills. • Anger expressed as retaliation. • Feeling of helplessness/lack of power. • Low self-esteem in general. • Victimized by society. • The fire-setting behavior is a response learned at an early age. • Compulsive behavior.	07-56-FI210-EP

OUTLINE	AIDS & CUES
Classification of Arsonists: • Single Arsonist – an offender who sets a single fire then ceases. • Spree Arsonist – an offender who sets fires at three or more separate locations with no emotional cooling-off period in between the fires. • Serial arsonist – a person who sets three or more fires, at either the same or different locations, with an emotional cooling-off period between the incidents. Note: Cooling-off period is the result of temporary psychological relief that results from the act of setting the fires.	07-57-FI210-EP
Behavioral Characteristics of the Serial Wildland Arsonist: • Will normally set fires primarily to vegetation, but may set fire to vehicles and structures. • 90+% operate within their comfort zone. • Often a precipitating stressor prior to fires. • Approximately 40% set fires exclusively in daylight. • Most drive to scene. • May remain on scene to watch fire or participate.	07-58-FI210-EP

OUTLINE	AIDS & CUES
• May remain nearby and watch from vantage point. • May return to crime scene. Note: Discussion with class about method of transportation. Data is from USFS study and FBI study. <u>Your Role as an INVF Suspected Arson scene:</u> • Follow agency policy. • Scene security and protection. • Request additional investigative resources as necessary. • Conduct origin investigation. • Collect evidence in accordance with agency policy. • Determine cause and ignition sequence. Note: Wait for arrival of a more qualified investigator. Perform all the normal activities associated with the location and protection of evidence, scene security and potential witness identification. Follow agency policy – Notification of LE Agency with jurisdiction if required.	07-59-FI210-EP

OUTLINE	AIDS & CUES
Arson Ignition Device Review:	07-60-FI210-EP
The following slides show various ignition devices as they were discovered at the scene, followed by photos of the pre-fire ignition device.	
Photo examples: Arson Devices	
Note: Remnants from a fusee. To the right of the finger is the remnant of the base of the fusee.	07-61-FI210-EP
Note: Slag from a fusee on top of the rock.	07-62-FI210-EP
Note: The recovered thick cardboard base of the fusee.	07-63-FI210-EP
Note: Fusee – pre-fire	07-64-FI210-EP
Flare: • Normally very obvious – May be buried under ash debris. • Hot set – Can be thrown from vehicle or hand carried. • Time delay – Balanced on rock or placed in partially cleared area.	07-65-FI210-EP

OUTLINE	AIDS & CUES
Suspect may have burn holes/residue on car upholstery or on clothing/shoes from flare/fusee slag:	07-66-FI210-EP
Note: Suspect who uses fusee as arson device may have residue or burn holes in his clothing or inside the vehicle.	
Note: Rope with matches tied to it.	07-67-FI210-EP
Note: Cotton rope device – pre-fire.	07-68-FI210-EP
Note: Incense stick with paper matches attached.	07-69-FI210-EP
Note: Incense stick with paper matches attached. Pre-fire.	07-70-FI210-EP
Note: Rock at ignition area.	07-71-FI210-EP
Note: When the rock at the ignition area is lifted some of the unburned newspaper that was the arson device is discovered.	07-72-FI210-EP
Note: The paper wrapped rock as an ignition device. Pre-fire (End of arson device review)	07-73-FI210-EP

OUTLINE	AIDS & CUES
Determination of Arson: • Once a determination of arson is made, proceed within the limitations of your role and authorities. • Make the necessary referrals according to your agency policy. • Remember to maintain strictest confidentiality: "Need to know." • Do not release any information to the public, media, or non-assisting agency.	07-74-FI210-EP
Unit 7 Objectives Review: 1. Define arson. 2. Describe the difference between arson and incendiary. 3. List the reasons why it may be challenging to solve wildland arson. 4. Identify arson investigation objectives. 5. Describe the indicators that identify an arson incident. 6. Recognize and describe a variety of arson ignition sources.	07-75-FI210-EP

OUTLINE		AIDS & CUES
7	Identify the six arson motive categories and their subsets.	07-76-FI210-EP
8.	Describe the psychology of arson.	
9.	Describe the classification of arsonists.	
10.	Identify the general profiles and behavioral characteristics of the serial arsonist.	
11.	Describe how to identify and preserve evidence at the scene.	
12.	Describe notification and referral procedures to law enforcement.	
Answer students' questions.		

UNIT OVERVIEW

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 8 – Court Preparation and Testimony

Time 1 Hour

Objectives

1. Identify key steps in the civil and criminal litigation processes.
2. Explain the relationship between the investigation report and testimony.
3. Define “expert witness” and “fact witness.”
4. Describe the role of an expert witness.
5. Describe the “expert witness” *voir dire* process.
6. List the elements of a *curriculum vitae.*
7. List the principles an investigator should follow when testifying.

Instructional Method(s)

- Informal lecture
- Classroom discussion

Instructional Aids

- ☐ Computer with projector, screen, and presentation software
- ☐ Sign-in sheet
- ☐ Flip charts and markers

UNIT PRESENTATION

Course Wildland Fire Origin & Cause Determination, FI-210

Unit 8 – Court Preparation and Testimony

OUTLINE	AIDS & CUES
Present unit title slide.	08-01-FI210-EP
Present unit objectives.	08-02-FI210-EP
1. Identify key steps in the civil and criminal litigation processes.	
2. Explain the relationship between the investigation report and testimony.	
3. Define "expert witness" and "fact witness."	
4. Describe the role of an expert witness.	
5. Describe the "expert witness" *voir dire* process.	
6. List the elements of a *curriculum vitae.*	
7. List the principles an investigator should follow when testifying.	
<u>DISCLAIMER AND CAUTION:</u>	08-03-FI210-EP
• NFPA 921 and FI-210 are only suggested guidelines; they are not required procedures.	
• Every case will be different and requires professional judgment on what investigative techniques will be used.	

OUTLINE	AIDS & CUES
Note: Stress that almost everything covered in this Unit may have legitimate exceptions.	
This Could Happen to You!	08-04-FI210-EP
• Witness for prosecution. • Witness for defense. • Witness in lawsuit between 3rd parties that relied on your report. – Check with agency as to being a witness when the agency is not a party. – Many federal agencies have Touhy regulations prohibiting employees from testifying absent: o Specific government interest; and o With written permission of agency head.	
Note: It really could happen to them, and not just in the wildland fire investigation context. Touhy regulations mean you may not testify in a trial or deposition, if the United States is not a party, and unless your agency grants you permission. This slide applies to federal employees rather than state employees.	

OUTLINE	AIDS & CUES
Example – EPA's *Touhy* Regulations: 40 C.F.R. § 2.404	08-05-FI210-EP
Procedures when an employee is subpoenaed: • (a) Copies of subpoenas must immediately be sent to the General Counsel . . ., with the recommendations of the employee's supervisors. The General Counsel . . . . determines whether compliance with the subpoena would clearly be in the interests of EPA. . . . • (b) If the General Counsel . . . denies approval to comply with the subpoena. . . the employee must appear at the stated time and place . . . , produce a copy of these regulations and respectfully refuse to provide any testimony or produce any documents.	
Note: Nothing to remember for the test here; just an illustration of typical Touhy regulations.	
Federal Employees Acting In Official Capacity: • If you receive a subpoena regarding matters within the scope of your official duties. • Fact and jurisdiction driven criteria. • Do not assume subpoena is valid. • Do not ignore it either. • Contact your supervisor and your legal staff before taking any action.	08-06-FI210-EP

OUTLINE	AIDS & CUES
Note: Do not overreact if you are subpoenaed, or ignore it either; talk to your supervisor before you do anything.	
THE CIVIL PROCESS	08-07-FI210-EP
Pre-Trial:	
• Complaint	
– Plaintiff presents theory of case and hoped for remedy.	
• Answer	
– Defendant's Response	
– Affirmative Defenses	
• Discovery	
– Both sides exchange all non-privileged relevant evidence.	
– Over 90% of contested cased do not get past the discovery stage.	
Discovery:	08-08-FI210-EP
• Interrogatories	
– List of written questions.	
• Requests For Production	
– Request to produce all documentary and physical evidence.	

OUTLINE	AIDS & CUES
• Requests for Admissions – Used to narrow the contested issues in a case.	
Note: This is how a typical American civil trial proceeds. Do not believe anything you see on TV about lawyers. Emphasize that 90% of cases do get settled, usually after discovery (which you will discuss next).	
Note: More "what to expect." It is important that the instructor emphasize that these discovery instruments have enforceable deadlines, with sanctions (possibly monetary) for failing to meet same.	
<u>Depositions (Examinations)</u> • Questioning is similar to trial. • Direct questions and cross examination. • Under oath and before a Court Reporter. • No finder of fact present. • Counsel's objections are for the record only (you still have to answer the question –unless instructed not to answer).	08-09-FI210-EP

OUTLINE	AIDS & CUES
Note: Just like a trial but without a judge. They have to answer all questions, but give your attorney a chance to object first. The trial may take weeks and you may be questioned by several attorneys, representing different parties.	
<u>Subpoenas:</u> • Subpoenas – A command by the court to present yourself for formal questioning at a deposition or for trial. • Subpoena duces tecum – A command by the Court to bring with you to the above questioning all requested documentation. • Know your agency's policy on responding to subpoenas.	08-10-FI210-EP
Note: The court is ordering you to be somewhere to be questioned; Sometimes with all your records. Again, do not overreact or ignore.	

OUTLINE	AIDS & CUES
Trial:	08-11-FI210-EP
• Settlement Conference – Local rules – Court ordered – Required by law	
• Pre-Trial Motions – Summary Judgment – Dismiss – Suppress evidence	
• Voir Dire – Qualifying expert witnesses. – Selecting a jury if jury trial.	08-12-FI210-EP
• Opening Statements	
• Testimony – Plaintiff first, then Defendant o Direct – No leading questions. o Cross – Leading Questions "should" be limited to subject of direct. o Re-Direct – Damage Control.	
Note: Voir dire can be almost a separate trial. Will cover in detail later. More "what to expect."	

OUTLINE	AIDS & CUES
• Final Motions	08-13-FI210-EP
• Closing Arguments	
• Jury Instructions	
• Finder of Fact (Judge or Jury) issues verdict (judgment)	
• Appeal	
– Appeals generally limited to issues of law, not findings of fact.	
– Federal system – mandatory mediation.	
Note: Appeals usually limited to issues of law; fact finding typically left to lower court; e.g., admission of evidence, qualifications of experts; objections to testimony, jury directions, etc.	
THE CRIMINAL PROCESS:	08-14-FI210-EP
Pre-Trial:	
• Indictment or Information	
– Grand jury issues "indictment."	
– Prosecutors issue an "information."	
o Charging crimes and the theory of case.	

OUTLINE	AIDS & CUES
• Arraignment – Accused pleads guilty/not guilty/*nolo contendere.* • Discovery (Generally only Prosecutor has to share evidence and information).	
Note: "What to expect" in a criminal trial: Nolo contendere means: "I will not contest it," usually treated by criminal court as a guilty plea. Difference is that in pleading nolo contendere, the plea cannot be used against the defendant in a subsequent civil proceeding. A charging method can also be a "violation notice." Some small fires may be charged through a violation notice rather than an indictment or information.	
<u>Trial:</u> • Pre-trial Motions – Suppress evidence • *Voir Dire* (selecting a jury and/or qualifying expert witnesses) • Opening Statements • Testimony • Final Motions • Jury Instructions • Finder of Fact (Judge or Jury) Issues Verdict	08-15-FI210-EP

OUTLINE	AIDS & CUES
Note: More what to expect in a criminal trial. Remember the criminal burden of proof is "beyond a reasonable doubt." Civil burden of proof is "preponderance of evidence," which essentially means that more likely than not that something happened in a certain way.	
Appeals:	08-16-FI210-EP
• Prosecutor can appeal almost any issue of law, but cannot appeal a verdict of not guilty, e.g., the Judge dismisses case without verdict. • Defense can appeal any issue of law.	
Note: If a judge dismisses case without a verdict, prosecutor can appeal.	
Witnesses and Their Roles: Title slide	08-17-FI210-EP
Types of Evidence:	08-18-FI210-EP
• Direct ("I saw him do it") – Documents – Eyewitnesses • Circumstantial or indirect – Proof of a chain of circumstances pointing to the existence or non-existence of certain facts. o "Footprints in dirt now matched shoes worn by suspect."	

OUTLINE	AIDS & CUES
• Judicial Notice ("tires are round")	
Note: Technically, "Judicial Notice" is a substitute for evidence, rather than evidence itself.	
Fact Witnesses:	08-19-FI210-EP
• Testimony based on factual observations.	
• Opinions or conclusions generally not allowed.	
• Most cases require fact witnesses.	
Note: The main difference is that an opinion can only be offered by an expert in that subject matter; what you saw, heard, felt, smelled, etc. Experts may offer fact testimony.	
Expert Witnesses:	08-20-FI210-EP
• Qualified by education, knowledge, skill, or experience.	
• Allowed to draw inferences, form conclusions, and testify as to opinions.	
• Most fire cases will require expert testimony.	
• Trial court judge determines expert witness qualifications.	
– In federal court, conclusions and methodology are examined using FRE 702 (*Daubert*) criteria.	

OUTLINE	AIDS & CUES
Note: The judge acts as a gatekeeper for the expert witness testimony. Note that the following "Daubert" process may not be followed by state, and/or crown courts. FRE = Federal Rules of Evidence.	
Federal Rules of Evidence: A witness who is qualified as an expert by knowledge, skill, experience, training, or education may testify in the form of an opinion or otherwise if: a) the expert's scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or to determine a fact in issue; b) the testimony is based on sufficient facts or data; c) the testimony is the product of reliable principles and methods; and d) the expert has reliably applied the principles and methods to the facts of the case.	08-21-FI210-EP
Note: Many states have similar, and often identical, Rules of Evidence. Be familiar with the relevant Rules of Evidence that your court may apply.	
Daubert v. Merrell-Dow Pharmaceutical Company US Supreme Court 1993: • Testimony must be relevant. • Testimony must be reliable.	08-22-FI210-EP

OUTLINE	AIDS & CUES
Note: These are the basic two prongs of expert testimony.	
Daubert v. Merrell-Dow Pharmaceuticals:	08-23-FI210-EP
To determine reliability, the trial judge acting as a "gatekeeper" may apply many factors, including but not limited to, the following tests to decide a proffered expert testimony's "reliability."	
• Can the theory or technique be tested?	
• Has the theory or technique been subjected to peer review?	
Note: The judge can use more than just these two criteria. "Gatekeeper" means the judge decides what evidence gets in and what doesn't get in.	
"Reliability" tests (cont.)	08-24-FI210-EP
• Is there a known or potential rate of error associated with this theory or technique?	
• Does this theory or technique have a general acceptance in that particular discipline's community?	
Note: The quality of your investigation, and your report, will reflect more on your ability to qualify as an expert, than your credentials.	

OUTLINE	AIDS & CUES
Michigan-Miller's Mutual v. Benfield: (11th circuit - 1998)	08-25-FI210-EP
• Fire investigation case in federal court.	
• Tendered expert's testimony excluded:	
– Failure to meet FRE 702 (*Daubert* test) standard.	
o Did not perform any tests or take any samples.	
o No scientific basis for opinion.	
Note: This is an example of what not to do; Investigators subjected to cross examination under Daubert are often appearing with their own attorneys, because if they fail to qualify as an expert, it could impact their career.	
Voir Dire: Qualifying Expert Witnesses:	08-26-FI210-EP
• First step in qualifying a proposed witness as an expert.	
– Trial within a trial.	
– Generally does not occur before jury, if jury trial.	
• Prosecution/plaintiff and defense counsel have significant freedom to question the proposed expert's qualifications.	
• Expert's qualifications must be established prior to giving expert testimony.	

OUTLINE	AIDS & CUES
Note: A similar voir dire process is also used to select juries; Occasionally, failure of a party to have its expert(s) qualified as an expert causes that party to consider settling the matter.	
• Prosecution/plaintiff and defense counsel establishes qualifications of their respective proposed expert witnesses.	08-27-FI210-EP
• Opposing counsel cross examines to reduce credibility of proposed expert witness.	
• Expert testimony allowed by judge if minimum "*Daubert*" qualifications are met.	
– Some jurisdictions do not use *Daubert*.	
• Trier of fact decides weight and credibility given to each expert's testimony.	
Note: The trial judge will tell you which subjects you are considered to be an expert on by the court. You will only be allowed to testify as an expert on those subjects, and they may be very limited.	
<u>Voir Dire - Curriculum Vitae:</u>	08-28-FI210-EP
• All proposed expert witnesses should possess an accurate and up to date "curriculum vitae."	
• Curriculum vitae should include:	
– Employment history	

OUTLINE	AIDS & CUES
– Training received (and passed) – Training conducted – Professional affiliations – Papers or publications written – Additional qualifications	
Note: A CV is often used as a replacement for a resume (a recruiting tool), and is often more detailed and complex. Pursuant to Rule 26 (a)(2)(A) of the federal rules of civil procedure, currently you are only required to disclose the last 4 years of testimony, and any of your publications within the last 10 years. You may wish to pattern your CV after this requirement in order to limit the issues addressed in cross examination. Maintaining the CV is an ongoing process and should not be put off to the last minute. If you don't have one now, go home and make one.	
<u>Implications for Wildland Fire Investigators:</u> • Know Your Qualifications. – Training or experience. – Do not exceed your qualifications. • Use a systematic approach.	08-29-FI210-EP

OUTLINE	AIDS & CUES
• Document actions and findings. • Are your conclusions corroborated and supported scientifically? – Have the other reasonable potential causes been addressed, if not why not?	
<u>Investigation Report and Testimony:</u> • Review case files, notes, documents, and evidence prior to testimony. • Obtain transcripts of prior testimony to ensure consistency with other cases. • You may use the investigative report to refresh your memory on the stand. – With the judge's permission. • Be prepared!	08-30-FI210-EP
<u>Principles of Effective Testimony:</u> For Trials and Depositions: • Always be on time. – Actually come a little early in case there have been any legal or other developments. • Wear proper attire. – Check with your counsel, uniforms or no uniforms.	08-31-FI210-EP

OUTLINE	AIDS & CUES
• Be physically and mentally prepared.	
• Sit comfortably, but erect without slouching.	
• Listen and respond carefully only to the question asked.	08-32-FI210-EP
– Do not volunteer information.	
• Avoid unintentional, non-verbal communications.	
• Pause a second before answering.	
– Allows your counsel to object if necessary.	
• Do not try to outsmart, or argue with, opposing counsel.	
Note: Get to know your attorney before trial, and find out his/her court room practices and preferences – no two attorneys are alike.	
• Provide responsive answers on direct examination (*i.e.,* answer the question asked).	08-33-FI210-EP
• On cross examination, if the question cannot be answered with a yes or no, you may explain your answer.	
• If the answer is incorrectly stated, correct it immediately or clarify it.	
• Avoid police or fire jargon, acronyms, or legalese.	

OUTLINE	AIDS & CUES
Note: Ask the students if they know what time it is – the answer should be "yes" or "no," not the time. Only answer the question asked. Do not volunteer information.	
• If you don't know the answer to a question, say "I don't know."	08-34-FI210-EP
• Do not exaggerate or make overly broad statements.	
– Never say "never," or "always," *etc.*	
• Be serious and avoid smiling or laughing.	
• When an attorney objects to a question, allow judge to rule.	
Note: Emphasize that attorneys love words like "never" or "always." "Oh, I would never do that!" "Oh really? What about . . . . . .? "	
• When questioned by opposing counsel do not look to your counsel for help.	08-35-FI210-EP
• Do not leave the stand until excused.	
• Do not leave the courtroom or courthouse without consulting your attorney.	
• Anything you look at while testifying can and will be examined by opposing counsel.	
• Refer to reports rather than notes, if possible.	

OUTLINE	AIDS & CUES
Note: Do not assume that because you are excused that you are done testifying.	
• Opposing counsel may attempt to impeach you for seemingly conflicting Deposition and Trial Testimony.	08-36-FI210-EP
• Seemingly different answers can often be reconciled.	
– Is the question different?	
– Are the underlying facts different?	
– Have you come upon new information?	
• Clarify without becoming defensive.	
• If you cannot explain the difference simply state which response is correct.	
Note: Do not panic, try to relax and then answer to the best of your ability.	
<u>Electronic Discovery:</u>	08-37-FI210-EP
Electronically Stored Information ("ESI").	
• When a federal agency reasonably expects litigation in federal court.	
• All ESI that may relate to that expected litigation must be "frozen" (preserved).	
– Format – Place	

OUTLINE	AIDS & CUES
• The process is often initiated by in-house counsel "Litigation Hold" letters. • ESI must be frozen until conclusion of litigation. Note: Become familiar with your agency's ESI procedures. Courts take this matter very seriously, and have sanctioned federal agencies that did not take ESI seriously. Some states may also adopt forms of ESI procedures – be familiar with the ESI procedures, if any, for your state.	
• Err on the side of retention. • If in doubt - consult DOJ/agency counsel prior to altering, deleting, or discarding. • Court ordered sanctions available for improper deletion/alteration.	08-38-FI210-EP
<u>Principles of Effective Testimony:</u> • The most important principle is to always tell the <u>TRUTH.</u>	08-39-FI210-EP

OUTLINE	AIDS & CUES
Review Unit 8 Objectives: 1. Identify key steps in the civil and criminal litigation processes. 2. Explain the relationship between the investigation report and testimony. 3. Define “expert witness” and “fact witness.” 4. Describe the role of an expert witness. 5. Describe the “expert witness” *voir dire* process. 6. List the elements of a *curriculum vitae.* 7. List the principles an investigator should follow when testifying. Answer students’ questions.	08-40-FI210-EP